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Workbook in home mechanics for special classes.

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# Workbook in Home Mechanics for Special Classes

by

Frances Aliene Scott

(B. S. in Education, Boston University, 1943)

Submitted in partial fulfillment of requirements

for degree of Master of Education.

1945

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Gift of F.A. Scott
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# INTRODUCTION

The following study is an effort to provide a practical course in Home Mechanics for Special Classes that are used as terminal rooms.

Because of slow academic progress, most of these children remain in special classes until age 16. They then leave school and are, for the most part, unprepared to meet the conditions of living as they find them since their education has not been planned with this in mind.

To attempt to meet this need, a year's course of 10 units in home mechanics was developed. Because vocabulary load adds so materially to the comprehension difficulties of special class children, all materials have been written on a third grade vocabulary. This level was selected arbitrarily as providing ample variety of expression while keeping comprehension difficulty to a minimum. All technical terms used have been illustrated, where practicable, to aid in easy comprehension.

## Chapter I

## SUMMARY OF PREVIOUS RESEARCH

Few writers give specific heed to the purposes of courses in Industrial Arts for Special Classes. The U. S. Office of Education[1] states that "operations, and processes and knowledges to be acquired by Special Classes in Industrial Arts should be those for normal children, modified to meet individual needs. Such a situation leaves little room for special shops provided in many schools where such children devote their time merely to weaving, caning chairs, coping saw work, basketry, and simple furniture." If one accepts this statement as a basis on which to build a Home Mechanics Course for Special Classes, what are the objectives for which to work?

Fryklund's[2] list of the aims of Household Mechanics in the Elementary School as "a subject in the general area of Industrial Arts in the Elementary School" is so comprehensive that it includes aims expressed by Kroll,[3] Mays,[4] Warner,[5]

[1] "Industrial Arts: Its Interpretation in American Schools." U. S. Office of Ed. Bulletin, 1937, No. 34.

[2] Fryklund, V. C. and Bedell, E. L. "Course of Study Construction in Industrial Education." Ind. Arts & Voc. Ed. 28:3;;-14. O. '39.

[3] Kroll, H. W. "Industrial Arts for Girls." bibliog. Ind. Arts & Voc. Ed. 25:330-1. N. '36.

[4] Mays, A. B. "New Industrial Arts for a New Day." Ind. Arts & Voc. Ed. 32:402-4. D. '43.

[5] Warner, W. E. "Industrial Arts Projects." Ind. Arts & Voc. Ed. 24:69-71. Mr. '37.

Fleming,[1] and Martens.[2] Fryklund[3] gives his aims as follows:

1. To develop interests in and understandings of materials involved in Household Mechanics--their source, characteristics, values, and uses.
2. To develop ability to change the more common materials of industry to meet the needs of the household.
3. To select wisely, care for, and use properly industrial products that are related to maintenance and comfort of the home.
4. To foster appreciation of good workmanship, good design, good materials, and good structure in the creative experience in household mechanics.
5. To develop habits of doing things safely and with regard to hygiene.
6. To provide opportunities for developing independence in planning and following through to successful completion individual and group projects.
7. To inculcate ideals and attitudes of readiness to assist and co-operate in a group.

1 Fleming, F. L. "Girls' Home Mechanics Club." Ind. Arts & Voc. Ed. p17, Ja' 33.

2 Martens, Elise H. "For Exceptional Children." School Life. 21:86. D '35.

3 Fryklund, V. C. and Bedell, E. L. "Course of Study Construction in Industrial Education." Ind. Arts and Voc. Ed. 28:311-14. O '39.

8. To develop habits of cheerful, orderly, and methodical performance of tasks in the upkeep of the home.
9. To provide experience that would awaken interest in and create intelligent understanding of occupations related to activities of home maintenance.
10. To learn to make and read simple drawings and diagrams for use in planning and construction [of simple needs in the home.]
11. To encourage development of hobby interests.
12. To study contributions of science, its men, materials, and history in relation to the activities of Household Mechanics in the Elementary School.

Start here

Fales[1] goes into the field of elementary economics in listing his aims of Industrial Arts courses for he includes an understanding of:

1. Labor
2. Materials
3. Equipment
4. Time-element in manufacture
5. Estimating of a job or contract
6. Costs of transportation of getting a finished article to its destination.
7. Prices of commodities.
8. Costs of repairs and replacements.

OK.

[1] Fales, R. G. "Industrial-Arts Teaching Content." Ind. Ed. Mag. 36:185-91. S.'34.

According to Preston,[1] the primary function of Industrial Arts is general education. It is his opinion that "being able to do these tasks around the home gives personal satisfaction, saves time and money."

Johnson[2] feels that "since the experience that boys and girls get in the modern home does not give them adequate handiness with tools or sufficient consumer intelligence about the products of industry for the efficient operation of a modern home" the schools of the United States today are doing the job, with varying success.

Fleming,[3] in this connection, states that the "use of hand tools [should be] emphasized for home jobs since most home owners do not own power tools."

In surveying desires of employers regarding the abilities of slow children for industrial employment, Martens[4] found that employers want children trained not in specific trade skills, but in"patience, manual dexterity, punctuality, and stability." Fleming[5] adds to this list "industry, initiative, resourcefulness, independence, exactness, and economy."

1 Preston, H. S. "Instruction in Home Mechanics and Maintenance for Girls in the Industrial-Arts Shop." Ind. Ed. M. 39:32-4. Ja '37.

2 Johnson, W. H. "Home Mechanics in the Chicago Public Schools" Ind. Arts. & Voc. Ed. 28:118-122. Mr '39.

3 Fleming, F. L. "Course for Future Home Owners." H. Sch. Jl. 23:139. Mr '40.

4 Martens, Elise H. "Educational Program for Adolescents." Jl. Home Econ. 29:437-41. S. '37.

5 Fleming, p.139.

More and more, people working in the field of Industrial Arts are coming to believe that girls should have training along these lines, particularly as Kroll[1] emphasizes that the girl "is the biggest purchasing agent as she spends the largest bulk of the national income." He continues, "Every girl who leaves high school should have a course in Industrial Arts, the purpose of which should be to take into consideration these very problems which she will meet as a prospective homemaker." Johnson,[2] too, cites a number of authorities as saying that girls get less such training than they need.

There is another side to Industrial Arts that should receive attention--what should be done about teaching related information?[3] Byrn asserts that a "well-rounded program of Industrial Arts is rich in knowledge content, artistic expression, well-designed projects which are of his [the child's] own design and choice and which serve his own needs." He amplifies this by adding that "A boy must feel accomplishment in knowledge as well as manipulative mastery." Byrn goes on to state that "a better knowledge of the technical phases of shopwork will enable a pupil to think and plan his work with so much greater dispatch that he will in most cases actually get more and better work done."

[1] Kroll, H. W. "Industrial Arts for Girls!" bibliog. Ind. Arts & Voc. Ed. 27:142-7. Ap. '38.

[2] Johnson, W. H. "Homecraft Training in Chicago Public Schools." School & Soc. 51:237. F.'40.

[3] Byrn, M. L. "Content Enrichment in Industrial Arts Courses." Education. 60:546-52. My. '40.

Rose[1] affirms that Industrial Arts courses should "teach a wealth of related and scientific information in close relationship with manual processes."[2] But in this connection, Ericson does not limit the related information to that which bears a close relationship. He states, "We are not making mechanics in the school shop, we are offering a means for receiving an education. And if this education is to be at all comprehensive, we must think of it in broader terms than simply producing articles of wood and metal.

Information, then, even if having only a remote relationship to the types of work being done in the shop, is justifiable, and to the larger number of students fully as valuable as the active tool and machine operations."

Hinderman,[3] too, is positive that related informational material is an essential part of the Industrial Arts course for he asserts, "Given adequate source and reference material and a suitable method by which the pupil, not the teacher, is the star-performer, I am convinced that the industrial arts pupil not only learns more, but is better motivated in what he

1 Rose, H. C. "Industrial Arts and the Girls." Ind. Arts & Voc. Ed. p.292. O. '35.

2 Ericson, Emanuel E. Teaching Problems in Industrial Arts. Manual Arts Press, 1930, p. 208.

3 Hinderman, R. A. "Leisure-Time Industrial-Arts Activities." Ind. Ed. Mag. 36:36-8. Ja. '34.

usually does" by the addition of subject matter, required readings, and outside study assignments to the manipulative activities of the industrial arts shop.

Smith[1] feels that the industrial arts teacher is not alone at fault in neglecting the knowledge side of his subject for he states: "Industrial Arts teachers must impart some information [as well as skills.] They want the pupils to know something. More would put much more emphasis on this informational side, to the great improvement of their work, if superiors, patrons, and students did not have such a grounded expectancy of products."

If related information should be a part of all Industrial Arts courses, of what should such material consist?

Smith[2] classifies the informational content of Industrial Arts courses as:

1. How to do a process correctly and safely.
2. Broadening and cultural but not essential knowledge about materials, etc.
3. Guidance information about working fields of each phase of Industrial Arts.

1 Smith, H. J. "The Industrial Art Teacher's Responsibility." Education. 52:605-9. Je. '32.

2 Ibid., p.

Reagh's[1] definition takes in less ground for it is "any information which explains and amplifies but is not absolutely necessary to the particular course from the skill or manipulative stand-point. It is that information which gives the course a tie-up with the field of industry."[2] Fales sounds a warning note on this subject when he states that the "historical study of industrial arts may easily be overdone."[3] Hinderman, like Smith,[4] includes directions for making and doing in his informational material and adds that all such material is "accompanied usually by photographs and brief statements of conditions under which the projects have served the contributor... the use of such reference materials...approximates true life situations."

"The use of related informational material," according to Coltharp,[5] "can add much to shop or laboratory courses through acquainting the pupil with the problems of industry, methods of processing raw materials, optional jobs or projects, and occupational information." He continues, "This material should be readily available, it should be drawn from other school areas, it should be related to industrial procedures, and it should challenge the pupil to greater activity."

[1] Reagh, A. L. "Supplementary Related Materials." Ind. Arts & Voc. Ed. 24:225-7. Ap. '35.

[2] Fales, R. G. "Industrial-Arts teaching Contnet." Ind. Ed. M.

[3] Hinderman, R. A. "Leisure-Time Industrial-Arts Activities." Ind. Ed. M. 36:36-8. Ja. '34.

[4] Smith, H. J. "The Industrial Art Teacher's Responsibility." Education. 52:605-9. Je. '32.

[5] Coltharp, R. J. "Evaluation of Industrial-Arts Textbooks." bibliog. Ind. Arts & Voc. Ed. 31:44-8. F. '42.

Friese,[1] too, feels that one aim of non-manipulative industrial arts is "to provide interesting technical information about the occupations represented in the school shop and others closely allied. Such technical information should satisfy a boy's craving to know 'why'."

According to the U. S. Office of Education,[2] the use of reference materials in Industrial Arts is increasing. Their criteria for evaluating such materials are: "readability, attractiveness, suitability, and general utility." The Bulletin goes on to state that "there appears to be no definite criteria to aid in the evaluation of textbooks in the field of Industrial Arts while in many other curricular subjects, evaluation is aided by score cards, question lists, etc."

Coltharp,[3] however, gives detailed standards:

1. Book should lay flat for less eye strain.
2. Brief title, with wide awake wording that suggests the book contains something new and different.
3. Size should not be so small as to reduce the number of illustrations.
4. Printed on unglazed white paper.
5. Use wide margins.
6. Short lines of printing (10 point type, 3 point lead).

[1] Friese, John F. Exploring the Manual Arts. Century, 1927.

[2] U. S. Office of Education, Bulletin, 1937, No.34. "Industrial Arts: Its Interpretation in American Schools."

[3] Coltharp, R. J. "Evaluation of Industrial-Arts Textbooks." bibliog. Ind. Arts & Voc.Ed. 31:44-8. F. '42.

7. Preface should give exact purpose of book.
8. Vocabulary and phrasing should be of the level for the grade which is to use the book, with short sentences throughout.
9. Material should be with psychological approach:
   a. In problem form.
   b. Principles and fundamental information should be presented in direct connection where they are to be used.
   c. Material should be presented so as to encourage constructive and independent thinking, arouse curiosity, challenge investigation, and inspire sustained work.

In order to teach a number of different activities in Household Mechanics in a general shop all at the same time, careful planning and the use of carefully designed materials are necessary. Bedell[1] asserts in this connection, "Where one teacher has to supervise several different units at a time, a text or lesson sheet is essential--since a pupil cannot remember all of a teacher's demonstration and explanation, nor remember it in correct order." Williams[2] adds to this idea when he states that the sheets are " a means of checking and clarifying a teacher's demonstration."

[1] Bedell, E. L. and Fryklund, V. C. "Course of Study Construction in Industrial Education." Ind. Arts & Voc.Ed. 28:311-14. O. '39.

[2] Williams, B. T. "Individual Instruction Sheets." Ind. Arts & Voc. Ed. 26:363-4. N. '37.

Wells,[1] too, writes that Individual Instruction Sheets "seem better than any other method of handling a varied program in Industrial Arts classes for they can be kept up to date yet they keep fundamental knowledge always available." The U. S. Office of Education[2] qualifies its approval of the use of Instruction Sheets by stating that their value is measurable "by the extent to which they stimulate pupils to do their own thinking and planning."

Although Friese[3] gives doubtful approval to the use of Instruction Sheets in his statement, "Instruction Sheets do have some valid uses in manual arts as a reference when a pupil is in a quandary," he adds, "They, however, give little choice of project." To this objection and to others brought up by writers who do not advocate the use of Instruction Sheets, Ericson[4] has a comprehensive answer. "The argument that some boys are not well able to take directions from written or printed material, or are not interested in doing so, has been raised against the wide use of instruction-sheets. At this point it may well be

1 Wells, G. K. "Teaching Related Information." Ind. Arts & Voc. Ed. 26:86-7. Mr. '37.

2 U. S. Office of Education, Bulletin, 1937, No. 34.

3 Friese, John F. Exploring the Manual Arts. Century, 1927.

4 Ericson, Emanuel E. Teaching Problems in Industrial Arts. Manual Arts Press, 1930.

said that success in later occupational life is so largely dependent upon the development of the ability to read and understand, that some training in this phase of education would seem very desirable, if not essential, for every boy. The habit of 'leaning on the teacher' ... might be effectively discouraged by the use of the instruction-sheet."

Newkirk and Stoddard[1] give wholehearted support to the use of such sheets. "Individual Instruction Sheets containing organized instructional material for the use of the individual pupils have taken a prominent place in shop instruction. They are absolutely essential to the teaching of a well-organized general-shop course." These authorities add a warning, however, that is echoed by all advocates of the use of Individual Instruction Sheets that they are "not to take the place of the teacher."

Williams[2] lists some specific reasons for the use of Instruction Sheets:

1. They give the teacher extra time to devote to individuals.
2. Such sheets help to raise the pupil's standard of workmanship by giving him a ready reference to help and guide him--and keep him working when he would

[1] Newkirk and Stoddard. The General Shop. Manual Arts Press, 1930.

[2] Williams. B. T. "Individual Instruction Sheets" Ind. Arts & Voc. Ed. 26:86-7. Mr. '37.

otherwise be waiting for the teacher's help.

Williams[1] then goes on to state that when "instruction sheets have been carefully constructed and are used properly, they require a pupil to analyze the job and instructions as he would not need to do under other methods; that these sheets help to overcome individual differences since the pupil can progress at his own rate and that they develop good habits of comprehension and of getting technical information silently."

Vreeland[2] feels that local criteria for judging the value of workbooks should be adopted since different localities present different individual needs. He advocates the use of workbooks because they "tend to foster an intimate personal relation between pupil and teacher; direct the pupil to seek the teacher's help when needed; stimulate in a wholesome way the assumption of responsibility by the pupil for all aspects of his work; and provide effective training in self-diagnosis." When they are well-written, Vreeland thinks that workbooks manage so that the pupil "reads several texts, delves into many related volumes, attempts experimental operations of his own. "

1 Williams, B. T. "Individual Instruction Sheets. " Ind. Arts & Voc. Ed. 26:86-7. Mr. '37.

2 Vreeland, W. "Good Workbooks from the Teacher's Point of View." Nation's Sch. 18:35-7. Jl. '36.

The differentiated assignments contained in such workbooks, according to Vreeland,[1] "provide a variety of opportunity for the different types of pupils in a class."

In discussing the make-up of Instruction Sheets, Operation Sheets, Job Sheets, or Workbooks in Industrial Arts, Selvidge[2] gives specific directions for making them effective:

I. Title (exact)

II. General Directions

1. To examine exhibit of similar work to see how it is done.
2. A statement that the pupil must read the whole sheet and make a list of the steps he will take in doing the job.
3. A statement that the pupil must make a list of the tools and materials he will need to do the job.
4. A statement that the pupil must have both of these lists checked by the instructor before he begins the work.

III. Specifications

1. All drawings, dimensions, and kinds of materials to be used are included.

IV. Information

1. Anything pupil needs to know to do job successfully.

[1] Vreeland, W. "Good Workbooks from the Teacher's Point of View." Nation's Sch. 18:35-7. Jl. '36.

[2] Selvidge, R. W. Individual Instruction Sheets. Manual Arts Press, 1934.

V. Directions for Doing Job

1. In separate paragraphs for each step.

2. Well illustrated.

VI. Checking

1. Instructor must check work at this point.

VII. Questions

1. Only such questions as have a real purpose.

VIII. References

1. One or two good references.

Further advice in the preparation of Instruction Sheets is added by Brennan[1] for he advocates the use of interesting photographs, line cuts, intriguing page layouts, short snappy titles, a close association of parts and materials lists with the diagrams referring to them, and the use of subheads to summarize the articles.

Coltharp[2] gives these directions in the use of illustrations. They should be:

1. All so nearly perfect as to present clearly and accurately the facts of the construction and operation.

2. Accurate in every detail.

3. Of a size to be easily understood.

4. Self-explanatory.

5. Interesting.

[1] Brennan, J. B. "Can We Improve Our Instruction Sheets?" il. diags. Ind. Arts & Voc. Ed. 26:87-9. Mr. '37.

[2] Coltharp, R. W. "Individual Instruction Sheets." Ind. Arts & Voc. Ed. 31:44-8. F. '42.

Coltharp[1] differs radically from Selvidge[2] in regard to references for the latter advocates only one or two while the former stresses the inclusion of a large number. Coltharp would seem to disagree with Brennan[3] on the use of headings for he states that they should be as few as possible and only to introduce new materials and experiences, which would not permit their use in summarizing.

Fryklund[4] presents a basis on which Industrial Arts material is divided for presentation. He states that the "Operation is the basis of the instructional unit. It is a manipulative process. Instruction Sheets are written in as many parts as there are parts of the whole to be taught. Any one part can be taught by itself when it is needed and can be reviewed when necessary."

The writers who feel that Instruction Sheets do not allow a pupil to use his initiative, etc. advocate the inclusion of many questions on such sheets to stimulate pupils to think for

1 Coltharp, R. W. "Individual Instruction Sheets." Ind. Arts & Voc. Ed. 31:44-8. F. '42.

2 Selvidge, R. W. Individual Instruction Sheets. Manual Arts Press, 1934.

3 Brennan, J. B. "Can We Improve Our Instruction Sheets?" il. diags. Ind. Arts & Voc. Ed. 26:87-9. Mr. '37.

4 Fryklund, V. C. "Course of Study Construction in Industrial Education." Ind. Arts & Voc. Ed. 28: 311-14. O. '39.

themselves. In this connection Shapiro[1] states that they "should be only those [questions which are] inherent to the job and should be for a specific purpose--to supplement or reinforce, the answer to be found on the job sheet or in the pupil's job experience."

Coltharp[2] is one of the few authorities who mentions the use of Job Sheets with mentally deficient children. He says, "Job Sheets as used in regular shops are not of very great value in the shop for the mentally deficient... However, the teacher in these classes may use very simplified sheets; in fact he should encourage the pupils to try to figure out something simple. Such sheets must be brief; must never contain more than three or four dimensions."

Byrn,[3] on the other hand, asserts "The Job Sheet has very little place in Industrial Arts-- except perhaps for the dullest."

Few authorities have written detailed courses in Home Mechanics for Special Classes. Therefore, reverting to the statement of the U. S. Office of Education[4] that for Special Classes "the operations, and processes and knowledges to be

1 Shapiro, M. "Job Sheet--Its Construction and Use." High Points. 21:47-53. Ja. '39.

2 Coltharp, R. J. "Individual Instruction Sheets." bibliog. Ind. Arts & Voc. Ed. 31:44-8. F. '42.

3 Byrn, M. L. "Content Enrichment in Industrial Arts Courses." Education. 60:546-52. My. '40.

4 "Industrial Arts: Its Interpretation in American Schools." U. S. Office of Ed. Bulletin, 1937, No. 34.

acquired should be those for normal children, modified to meet individual needs," one can include nearly anything and find an authority to back up one's choice.

A survey of articles[1] dealing specifically with content of Industrial Arts courses gives a variety of over thirty subjects to be included. Analyzing further, one finds the numbers of authors sponsoring particular subjects varies from only one or two who advocate the inclusion of Household Safety to seven or eight who desire the inclusion of the Selection and Care of Clothing. Other subjects included frequently are:

Plumbing --5

Selection and Serving of Food --6

Etiquette --7

Crafts --4

Textiles --5

Room and House Planning --6

Mechanical Drawing --5

Care and Use of Common Tools --4

Budgetting --5

Electricity --4

Such a survey is exclusive of workbooks in the field of Home Mechanics. These workbooks include of the above subjects:

Plumbing

Upholstery

[1] A list of these articles appears in the Appendix, Page

Mechanical Drawing

Care and Use of Tools

Electricity

Other subjects included in most workbooks in Home Mechanics are:

Cutting and Setting Glass

Preparation and Use of Glue

Wood Finishing

Care of Brushes

Applying New Screening, Patching Screening

Soldering

Furniture Repair

Window Shades and Rollers: Adjustment and Replacement

These workbooks when studied individually may vary in one or two subjects. Collectively they include the above list, plus a number of other subjects which are not generally included.

One may, then, make up a course in Home Mechanics for Special Classes based upon such a broad field of subjects and fail to satisfy all by one's choice while partially satisfying many authorities in the field of courses designed for normal children.

Just as few authorities have designed courses in Home Mechanics for Special Classes, so have very few written tests to be used in this field. The field of testing in Industrial Arts for normal children has been poorly developed. Those parts of existing tests that are purely verbal would, if used for children with poor reading ability, penalize them at the start. According to Newkirk,[1] tests in Industrial Arts should cover the following list of subjects;

1. Information
2. Evaluation of product of tool, machine, or instrument operation. (Use rating scale for this as it is difficult to be objective.)
3. Technique
4. Speed
5. Reading of technical symbols
6. Comprehension of instructions or related information when read
7. Spelling of technical words
8. Mathematics used in connection with industrial arts
9. Appreciation of merit and qualities of merit in products
10. Language
11. Planning, layouts
12. Inventiveness (transfer of uses and methods)

[1]Newkirk, L. V. "Testing the Results of Industrial Arts Instruction." Education. 60:595-601. My. '40.

13. Personality (Social and Industrial Adjustment)

14. Mechanical Aptitude

15. Intelligence

Goldberg,[1] in a discussion of testing for Industrial-Arts courses, wants the tests to be "frequent, to measure technical skill, habits of work, co-operativeness, attitudes toward work, effort required, improvement in quality of work and the time required to perform it." Such testing could hardly be other than subjective, for the most part.

Fryklund and Bedell[2] advocate an Inventory Test on all incoming children in Industrial Arts classes to place them in regard to their abilities and subject matter knowledge in Home Mechanics, and they suggest the Detroit form. They also use a final test after a year's work to judge the pupils' growth. One notes that these writers state that "such tests should be carefully analyzed by the teacher to locate her strong and weak points of instruction."

A survey of previous work done in the field of Home Mechanics for Special Classes seems to show that it is a comparatively untouched field which is still in the state of opinion and conjecture. Therefore, the following workbook is an attempt to make a beginning in meeting this situation in a definite and concrete manner.

[1] Goldberg, R. D. "Use of Instruction Sheets in Sixth-Grade Clothing Classes." J. Home Econ. 25:26-7. Ja. '33.

[2] Fryklund, V. C. and Bedell, E. L. "Course of Study Construction in Industrial Education." Ind. Arts & Voc. Ed. 28:311-14. O. '39.

## Chapter II

## SETTING UP WORKBOOK IN HOME MECHANICS FOR SPECIAL CLASSES

This Workbook in Home Mechanics was developed to meet the needs of mentally retarded children to whom the Special Class was a terminal room. The materials, with the exception of the technical words, were written on a third grade vocabulary in an effort to present as little reading difficulty as possible. As many technical phrases as could be were illustrated to facilitate their comprehension.

The workbook has been divided into 10 units of which two are given in the text, pages

Each unit is subdivided into six parts:

1. Related Optional Activities
2. Pre-Tests
   a. Tools and Materials
   b. Procedures
   c. Related Background Information
3. Worksheets for Standard Jobs
   a. Operation Sheets
   b. Procedure Sheets
4. Related Information
5. Evaluation
   a. Tools and Materials
   b. Procedures
   c. Related Background Information

6. Bibliography

a. For pupils

b. For teacher

Description of Material

1. Related Optional Activities

These activities are in illustrated form and are placed first in each unit to help motivate the Standard Job. These activities consist of many suggestions for projects, to be made after the unit is completed, using skills and knowledges acquired in completing the required work of the unit. Any other activity suggested by the pupil that requires similar skills and knowledges can be substituted for any of these, or may be carried on as hobby work in addition to any of the related optional activities.

2. Pre-Tests

In order to know where a pupil stands in subject matter and knowledge of procedure before his beginning a new unit, pre-tests are provided. Where the ability and knowledge of the child is well known to the teacher, such pre-tests can well be ommitted. The tests are of the following types:

a. Identifying pictures

b. Filling in blanks with lists of words supplied

c. Multiple choice

d. Numbering steps in procedure in the correct order

e. Checking names of tools and materials needed to complete a standard job

f. Explaining riddles that show comprehension of correct procedures, materials, etc.

g. Sketching

h. Labeling parts of sketches

i. Matching phrases of definition to technical words

j. True-false

k. Crossing out irrelevant directions in procedures

l. Arranging phrases under correct headings

m. Numbering parts of a sketch to show order of procedure

The tests are constructed to require as little reading ability as possible while testing the pupil's knowledge of special vocabulary and procedures needed to complete each unit.

3. Worksheets

The worksheets for each standard job are divided into two parts:

a. Operation Sheets--which are detailed instructions telling how to do each special operation in a unit.

b. Procedure Sheets--which are detailed step-by-step directions telling how to complete the whole standard job. These sheets refer to Special Instruction Sheets wherever necessary.

These worksheets are illustrated for easier comprehension. Both Operation and Procedure Sheets are starred at intervals. These stars indicate the points at which the pupil must have his job checked by the instructor before he proceeds further.

4. Related Background Information

Each unit is accompanied by a section for silent reading. The material presented gives up-to-the-minute uses of the materials common to each unit, speculates about future uses, reviews the most interesting past uses. Sources of basic materials and tools that are used in completing each standard job are included if this contributes to the interest of the material. All associations of unit material with community life today are emphasized to increase the child's understanding of his environment.

5. Evaluation

Tests similar, but not identical, in nature and construction to those used for pre-tests are included to give teachers and pupils an opportunity to check growth. They should be used by the teacher to analyze carefully in order to discover the deficiencies and the best points of her teaching.

6. Bibliographies

A short list of reference materials for the pupil is included at the end of each unit. These references include some books which give more operations and procedures. Others present further reading material about the unit in general.

A bibliography on operations and procedures is included for the teacher since many Special Class teachers are not Industrial Arts specialists and may need to familiarize themselves further in unit procedure before the pupils begin work.

A number of source materials are also listed to help the teacher increase her own background knowledge in those areas in which she may not be fully prepared.

# Chapter III

## SUMMARY AND CONCLUSIONS

The purpose of this study was to provide a Workbook in Home Mechanics for Special Classes which would give the pupil skills, knowledges, and interests that would help him to earn his living, to be an intelligent consumer, to use his leisure-time to advantage--in short, to become a self-reliant, self-respecting citizen.

The workbook is made up of the following 10 units:

1. Working Drawings
2. Wood Finishing
3. Care of Brushes
4. Gluing
5. Upholstering
6. Glazing
7. Screening
8. Plumbing
9. Electricity
10. Care of Leather

Each unit is divided into six parts:

a. Related Optional Activities

b. Pre-Tests

c. Worksheets

d. Related Background Information

e. Evaluation

f. Bibliography

The ability to perform the tasks covered by these phases of home maintenance will save a home owner both time and money, as well as give him justifiable pride and self-respect in being able to do such work well. The optional related activities which the pupil completes after finishing each unit's standard job provide hobby interests for leisure-time occupation, while the related background information introduces the pupil to informational reading directly connected with his work and so opens avenues of reading with which he might otherwise never become familiar.

# Chapter IV

## SUGGESTIONS FOR FURTHER RESEARCH

I. Problems suggested while selecting topics for units

1. An interest survey among Special Class pupils of what they would like to know how to do, to use as a check list for Related Optional Activities.
2. An analysis of skills necessary to hold jobs which are filled by Special Class pupils after they leave school.
3. An evaluation of the workbook operations and procedures, unit by unit.
4. An evaluation of the vocabulary difficulty of the operation and procedure sections of each unit.

II. Problems suggested while preparing background information

1. Evaluation of each unit with regard to interest.
2. Evaluation of material with illustrations vs. the same material without illustrations.
3. Evaluation of material with regard to vocabulary difficulty.
4. Evaluation of complete unit including background reading vs. complete unit without background reading.
5. Evaluation of test as a time-saving device.

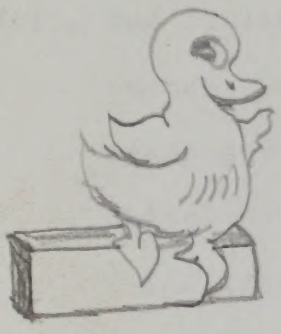
## Sample Units

The following section contains two sample units. The complete workbook is to be tried out in schools for vocabulary difficulty, efficacy of illustrations, degree of detail necessary in procedure instructions, worth of pre-tests, interest factor in background information, etc. The units will then be available in published form for use as a textbook.

Wood-Finishing

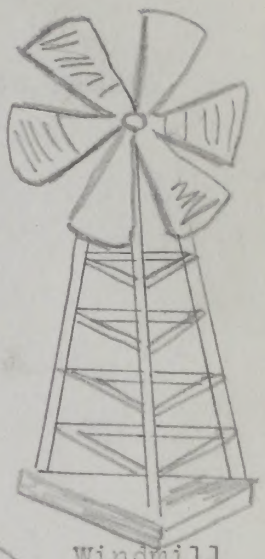
Wood-Finishing

Related Optional Activities



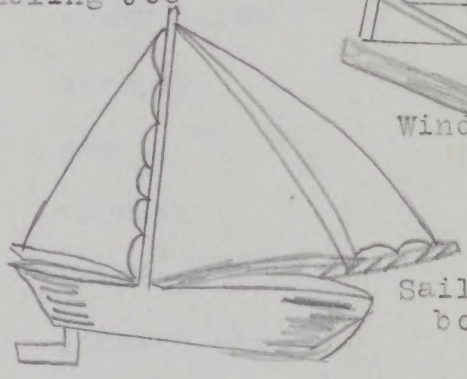
Door Stop

Tumbling Joe



Windmill

Model Airplane



Sail boat

Stool

Book ends

Birdhouse

# Wood-Finishing

## Pre-Tests

I. Tools and Materials needed for Wood-Finishing

Directions:
Check the tools amd materials needed to smooth, fill, and finish a book shelf for your room.

| | |
|---|---|
| hammer | putty |
| sandpaper | paste filler |
| chisel | burlap |
| 2 1/2 inch brush | block |
| stiff brush | emery paper |
| pumice stone | scraper |
| putty knife | saw |
| oil stain | varnish |
| enamel | whiting |
| pliers | linseed oil |
| turpentine | |

II. Procedures in Wood-Finishing

A. Preparing Wood for Finishing

Directions:

Number the following items to tell correctly how to prepare for staining an end table that you have made.

Rub down with No. 0 sandpaper on a block.

Use scraper on highest spots.

Take out dents by wetting surface thoroughly, then going over surface with warm iron.

Remove all excess glue.

Sand across grain on ends.

Brush work with a stiff brush to see if all surfaces are smooth.

Fill holes and cracks with prepared crack filler, plastic wood, or a mixture of sawdust and glue.

Rub with No. 1 sandpaper, using sandpaper block.

II. Procedures in Wood-Finishing

B. Applying Water Stain

Directions:

Number the following items to tell correctly how to apply Water Stain to your well-smoothed end table.

Apply stain with brush to lower end and inside parts.

Sand smooth with No. 0 or 00 sandpaper to remove fuzziness.

Sponge wood with plenty of luke-warm water and allow to dry.

Apply diluted stain to light sapwood streaks and end grain. Allow to dry 2 hours.

Apply stain to top.

Allow to dry 6 hours.

Look at all edges and ends for drips, and brush them out.

Allow to dry 2 hours.

Sand lightly with worn piece of No. 00 sandpaper.

Start applying stain in middle of surface and work toward ends.

II. Procedures in Wood-Finishing

C. Applying Oil Stain and Fillers

Directions:
Draw a ring around the answer that completes each of the following statements correctly.

1. When using oil stain, apply stain to end grain
   with a brush.
   with a cloth.
   undiluted.

2. Before wiping with a cloth, allow oil stain to dry
   2 or 3 minutes.
   2 hours.
   6 hours.

3. Apply all stains, varnishes, and paints to surfaces
   with the grain.
   across the grain.
   with a circular motion.

4. Apply oil stain to
   a shellacked surface.
   glued surface.
   unfinished surface.

5. Use paste fillers for
   open-grained woods.
   close-grained woods.
   all woods.

6. Apply all fillers
   across the grain.
   with the grain.
   very thick.

7. Wipe off all fillers
   across the grain.
   with the grain.
   at once.

8. Sandpaper filled wood
   with No. 1 sandpaper.
   with No. 00 sandpaper.
   with sandpaper on block.

9. Close-grained woods are usually filled with
   varnish.
   shellac.
   paste filler.

10. Woods to be used outdoors should be filled with
    oil filler.
    shellac.
    glue and sawdust.

II. Procedures in Wood-Finishing

D. Varnishing and Polishing

Directions:
Number the itmes in each set below in the order in which you would use them in varnishing and polishing.

Set 1

No. FFF pumice stone

No. F pumice stone

rotten stone and sweet oil

No. 00 sandpaper

Set 2

straight varnish

diluted varnish

rubbing varnish

II. Procedures in Wood-Finishing

E. Enameling or Painting

Directions:

A wall shelf that you have made for your mother is ready to be enameled. Number the items below to tell the order in which you will finish the shelf.

Apply coat of thin shellac.

Fill holes, sand carefully.

Rub with No. 0 sandpaper.

Apply under or priming coat.

Sand with No. 1 sandpaper.

Allow 1 hour to dry.

Allow 24 hours to dry.

Apply first coat of enamel.

Rub down with No. 1 sandpaper.

Allow 3 to 4 hours to dry.

Rub to a gloss with rotten stone and water or with pumice and water.

Apply second coat of enamel.

Rub down with pumice and water.

Wipe and polish with dry cloth.

III. On Background Information

Directions:
Check the words that complete each sentence correctly.

1. When the hands and faces of watches and clocks are painted with paint made of phosphorous
   - they can be seen in the dark.
   - they wear longer.
   - they keep better time.

2. Camouflage means to
   - make things fireproof.
   - make things so they can be seen at night.
   - make things seem to disappear.

3. Fireproof paint contains
   - asbestos or borax.
   - phosphorous.
   - aluminum.

4. To make iron rustproof, it is painted with
   - phosphorous.
   - red lead and oil.
   - aluminum.

5. Barnacles can be kept from forming on ships' bottoms for some time
   - by scraping the ships' bottoms with a special scraper.
   - by using fireproof paint.
   - by using a poisonous paint.

6. Rooms painted with gray, blue, or green will seem
   - warm.
   - cool.
   - small.

7. Using dark paint on a ceiling makes a room seem
   - low.
   - high.
   - large.

8. Camouflage paint has to be
   - a gloss paint.
   - a dull flat paint.
   - a phosphorous paint.

9. Dull flat paint contains
   - very little turpentine.
   - very little varnish.
   - very little color.

III. On Background Information

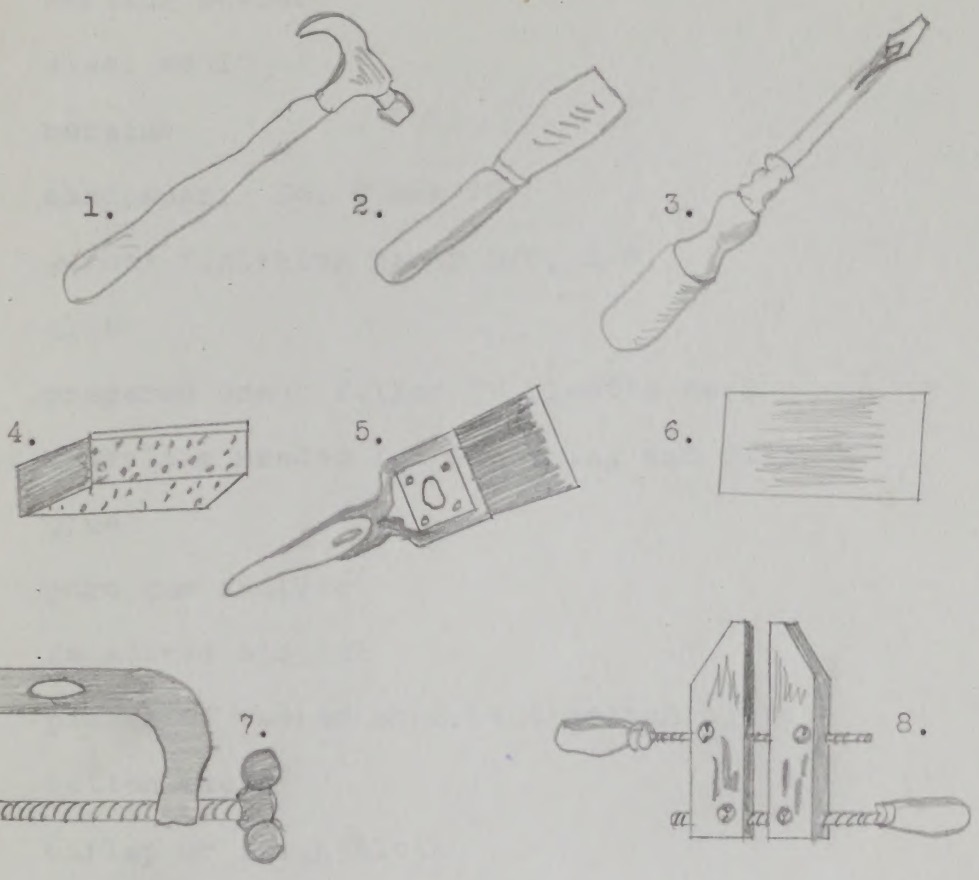
10. Shellac is made from
varnish.
turpentine.
an insect boring holes in the bark of a tree.

11. The domes of some of our public buildings are covered with
aluminum.
gold leaf.
fireproof paint.

12. Plastic paint dries to look like
a china plate.
window glass.
aluminum.

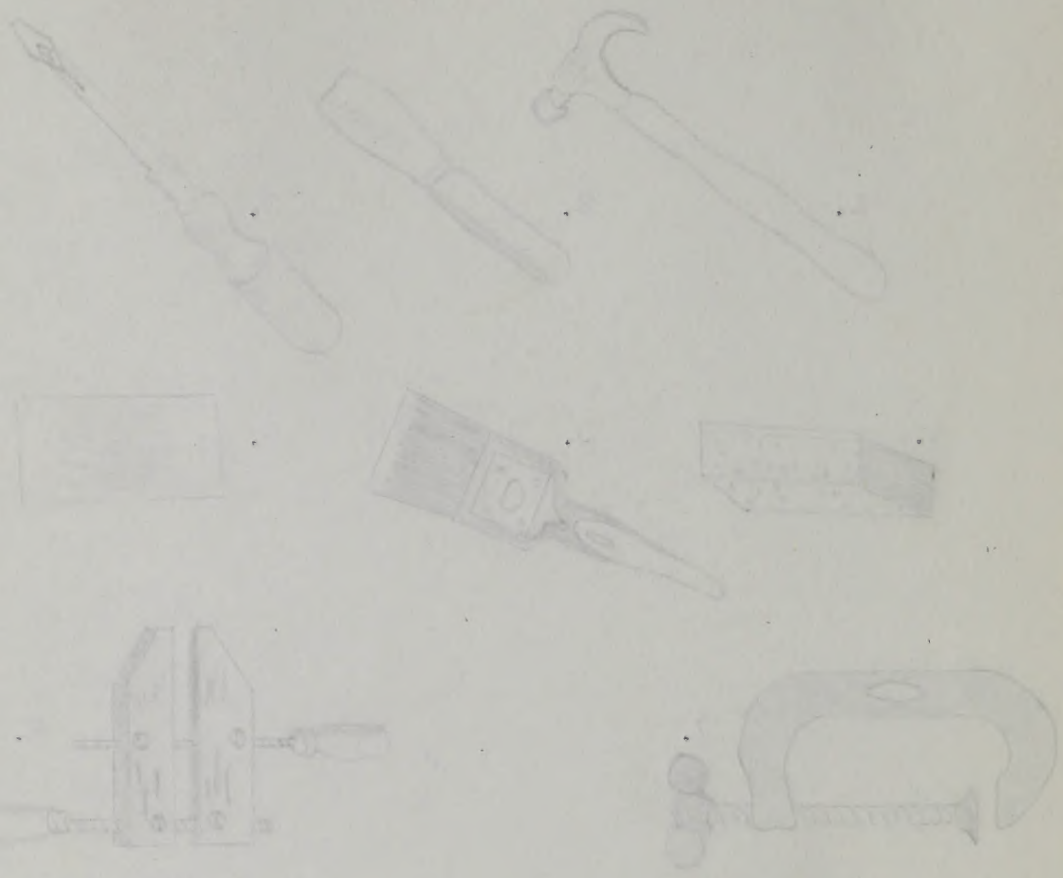
# Wood-Finishing

## Tools and Materials




Tools needed for Wood-Finishing

1. hammer
2. putty knife
3. screw driver
4. sandpaper block
5. varnish brush
6. scraper
7. C clamp
8. handscrew



## Wood-Finishing

101. Materials needed for Repairing Furniture

paint remover

washing powder

steel wool

benzine

sandpaper: No. 0 and 00
or
garnet finishing paper 2/0, 4/0

glue

prepared crack filler or plastic wood

102. Materials needed for Smoothing and Filling

glue

pure gum shellac

denatured alcohol

pieces of washed absorbent cotton cloth

cotton waste

burlap or rough cloth

silica

sandpaper, No. 1, 0, 00

plastic wood or crack filler

paste filler

103. Materials needed for Staining

scrap wood

sandpaper, No. 0, 00

Water, Spirit, or Oil Stain

2 brushes

a. 2 1/2 to 3 inches with beveled tip, rubber-set bristles

b. small fine-bristled brush, rubber set

Waste or absorbent cotton cloth

## Wood-Finishing

104. Materials needed for Varnishing and Polishing

3" rubber-set beveled tip varnish brush

turpentine

varnish

sandpaper, No. 00

soft cloth

pumice stone, No. F, FFF

old cheesecloth or handkerchief

harness-maker's felt, 3x5 inches

sweet oil

rotten stone

105. Materials needed for Enameling and Painting

sandpaper, No. 1, 00

paste or liquid filler

shellac

denatured alcohol

enamel priming or under coat

2 1/2 inch beveled tip varnish brush

turpentine

harness-maker's felt, 3x5 inches

pumice stone

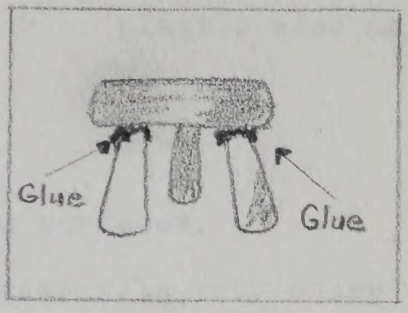
rotten stone

# Wood-Finishing

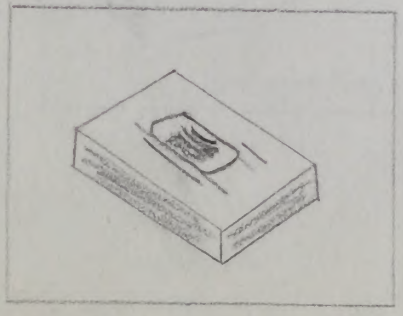
## Special Instructions

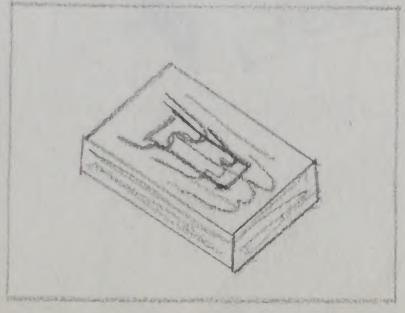
201. Preparing Surface of Unfinished Wood

1. Remove all spots of grease and marks by rubbing surface of wood with cloth dipped in benzine.
2. Remove all excess glue with sandpaper or with scraper. Do <u>not</u> scrape closely enough to injure the wood.




3. Remove glue from pores of wood to permit stain to enter the wood.
4. Wring cloth out of very hot water and lay it over spots of glue. Do this several times, until glue has been removed from surface and pores of wood.
5. Fill holes.
   a. Splinters or gouges
      (1) Large holes--Glue in a piece of wood to match the grain of the rest of the board.





201. Preparing Surface of Unfinished Wood

5. Fill holes

b. Small cracks or holes

(1) Mix fine sawdust of the wood you are using with glue to make a thick paste.

(2) Fill hole with this paste. Do not allow paste to spread over onto wood around hole.

(3) Prepared crack filler or plastic wood may be used instead.

6. Sandpapering

a. Rub <u>with</u> grain of wood on surfaces.

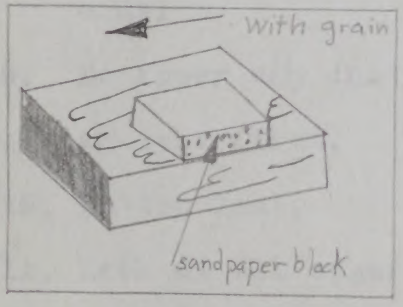
b. Remove any slight unevenness with very sharp scraper.

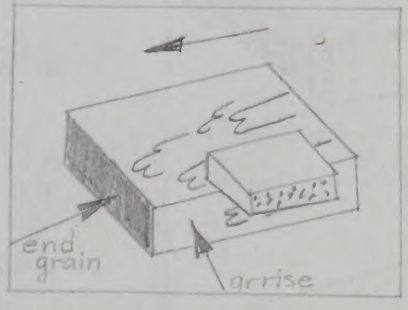
c. Rub down with No. 1 sandpaper on block.

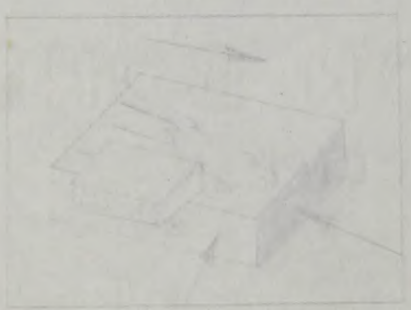
d. On ends, rub <u>across</u> the grain.

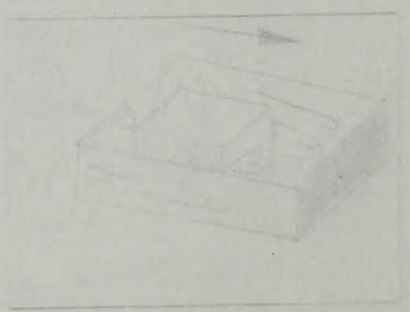
e. Do not round off corners or arrises.

f. Brush off work carefully with stiff brush to see if it is all smooth.







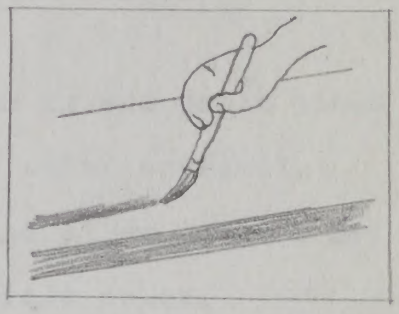
# Wood-Finishing

## Special Instructions

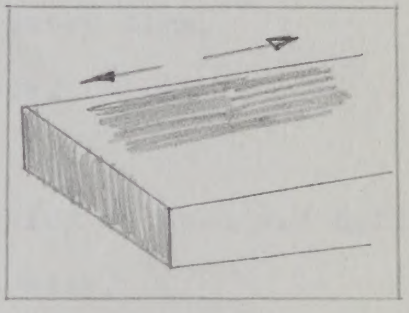
202. Staining

A. Water Stain

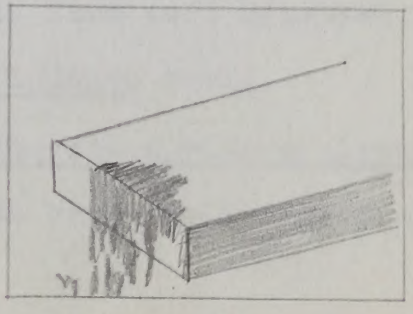
1. Sponge wood with plenty of luke-warm water and allow to dry.
2. Sand with No. 0 or 00 sandpaper to remove fuzziness.
3. * Add 1 part boiled vinegar to 7 parts stain.
4. Apply diluted stain to sap streaks, using small brush with fine bristles set in rubber.



5. * Allow to dry 2 hours.
6. Sand again.
7. Apply even coat of stain to article. Use enough stain on brush to flow easily but not to drip.
8. Start from middle of surface and work toward both ends.



9. Do lower and inside of article first.
10. Do top last.
11. Look at all edges and ends for drips, and brush them out.



12. * Allow to dry 6 hours.

13. Sand lightly with worn piece of No. 00 sandpaper.
14. If 1 coat of stain does not give dark enough color, apply second coat and let dry.
15. If open-grained wood, apply paste filler of color that matches.
16. Apply coat of very thin shellac ( Gum shellac 6 oz. to 1 qt. of alcohol) to keep stain from bleeding.
17. Allow to dry thoroughly.
18. Sand with No. 0 sandpaper, with the grain.

B. Staining End Grain

1. Use stain only 1/2 strength as end grain takes up stain more quickly than other surfaces.
2. Apply several thin coats and allow ends to dry between coats to match surface color.

C. Spirit Stains

1. Apply with brush.
2. Allow stain to remain on a short time.
3. Wipe off with absorbent cloth.

D. Oil Stains

1. Try stain on scrap of same kind of wood and dilute stain until color is as you wish.
2. Use 2" rubber-set brush with firm soft bristles.
3. Apply only on unfilled, unfinished wood.
4. Do end grains first, applying stain with a cloth.
5. Using long even strokes with brush well-filled

but not dripping, apply to lower and inside surfaces.

6. Apply stain to top last.

7. Remove all excess stain with dry cloth, rubbing with grain.

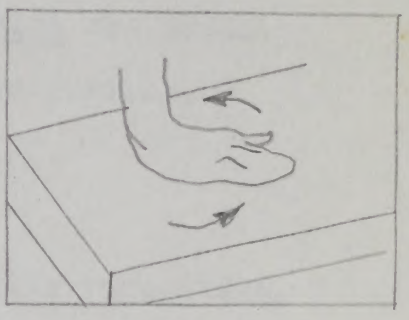
# Wood-Finishing

## Special Instructions

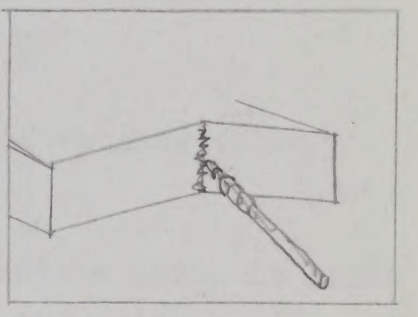
203. Wood Fillers

A. Paste Fillers--for open-grained woods

1. Brush surface with stiff brush to clean pores of wood.
2. Apply paste filler with stiff brush <u>across</u> the grain.
3. Brush in well.
4. Rub with palm of hand in a circle.
5. Allow to dry until it is dull in color. (15-20 minutes.)



6. Wipe off <u>across</u> the grain with burlap or rough cloth.
7. Remove all excess filler with clean cloth.
8. Use sharp stick covered with clean cloth to get excess filler from corners.



9. Wipe lightly with cotton waste, <u>with</u> the grain.
10. Allow 24 hours to dry.
11. Sand, by hand, with No. 0 or 00 sandpaper. Rub <u>with</u> the grain, <u>lightly</u>.
12. Wipe with cloth moistened with turpentine.

Wood-Finishing

Special Instructions

203. Wood Fillers

B. Liquid Fillers--for close-grained woods.

1. Use pure white shellac, thinned to 1 part shellac to 1 part denatured alcohol.

2. Allow to dry 5 to 6 hours.

3. Rub with No.00 sandpaper, with the grain.

4. Apply second coat of thinned shellac.

5. Allow 5 to 6 hours to dry.

6. Rub again with sandpaper.

7. Wipe with cloth moistened with turpentine.

8. Apply 1 coat of good grade varnish. See Instruction Sheet 204-C.

9. Allow to dry 4 or 5 days.

C. For Exterior Furniture

1. Mix enough silica to any good varnish to make a thin paste.

2. Dilute this paste with turpentine until it flows easily.

3. Apply 1 coat and allow to dry over night.

4. Rub down with No. 0 sandpaper.

5. Apply second coat of filler paste and allow to dry over night.

6. Rub again with No. 0 sandpaper.

7. Apply 1 coat of Spar varnish. See Instruction Sheet 204.

Wood-Finishing

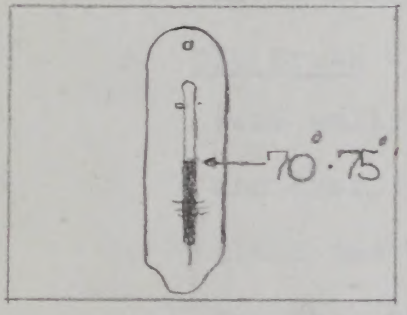
Special Instructions

204. Varnishing and Polishing

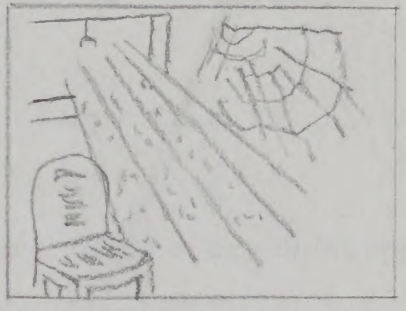
A. Conditions for Varnishing

1. Keep temperature about 70 to 75 degrees.
2. Do not work on a day that is too damp or too dry.
3. Keep air free from dust.
4. Do not work in a breeze nor in direct sun.

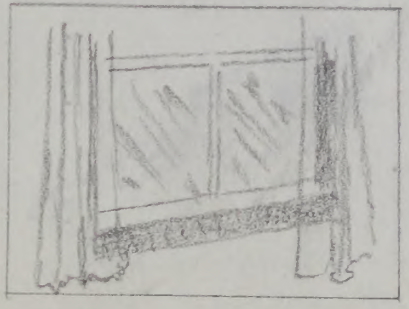
Varnish today



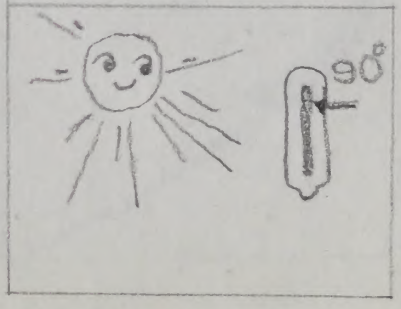

Do not work here



Too damp today



Too dry today



Wood-Finishing

Special Instructions

204. Varnishing and Polishing

B. The Brush

1. Size

For large surfaces, use a 3 inch, rubber set brush with long soft hair bristles. Buy good brushes and take good care of them.

2. New Brush

Wash new brush well in warm water.

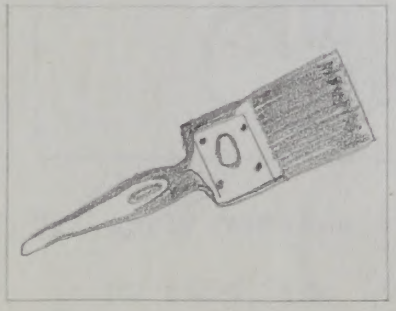
Allow to hang in water or turpentine over night to set the bristles.

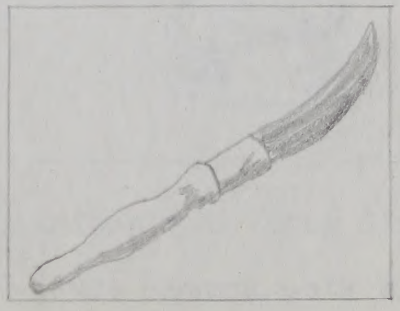
Allow brush to dry thoroughly.

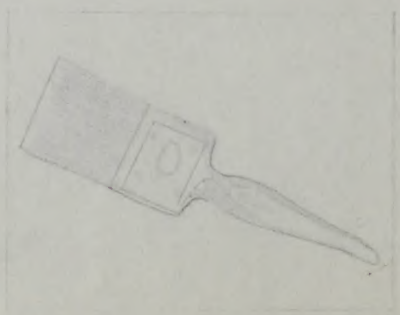
3. Old Brush

Wash well in turpentine to get out all dirt and dust.

Clean the part of the brush where the bristles are set, also.





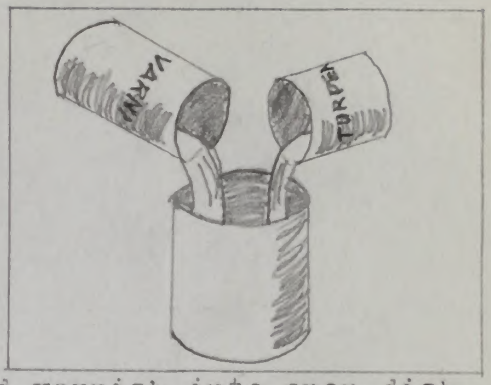


Wood-Finishing

Special Instructions

204. Varnishing and Polishing

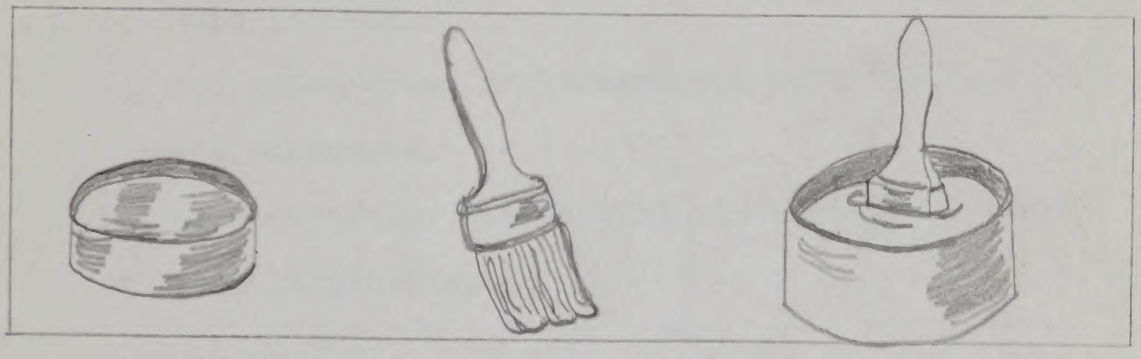
C. First Coat of Varnish



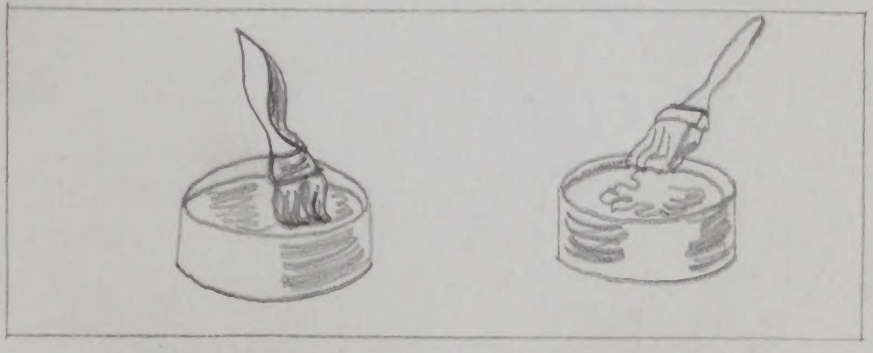

1. Thin varnish, using 1 part turpentine to 3 parts varnish.
   Mix well.

* 2. Pour small amount of thinned varnish into open dish.

3. Fill brush well with thinned varnish.
   Dip brush into varnish the full length of the bristles.



4. Remove excess varnish from brush by drawing brush **against** the side of the dish or can.



5. Apply varnish to surface with long firm strokes, working from the middle toward both ends.

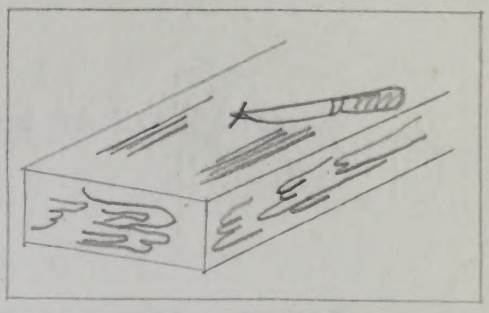
6. Work quickly.

Wood-Finishing

Special Instructions

204. Varnishing and Polishing

C. First Coat of Varnish



7. Take up any dropped bristles with a thin knife.

8. Take up any extra varnish at the lower corners of surface.

* 9. Allow first coat of varnish to dry 48 to 72 hours.

10. Rub lightly, with grain, with No. 00 sandpaper, held in hand.

11. Put a few drops of linseed oil onto the back of the sandpaper.

12. Dust carefully with a soft cloth just moistened

* with turpentine.

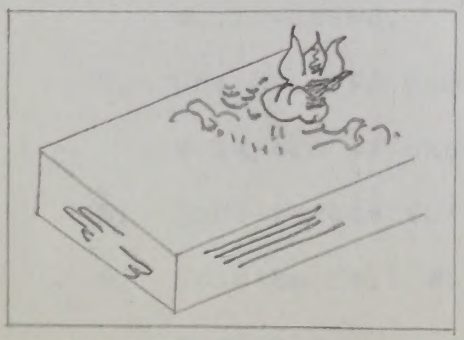
Wood-Finishing

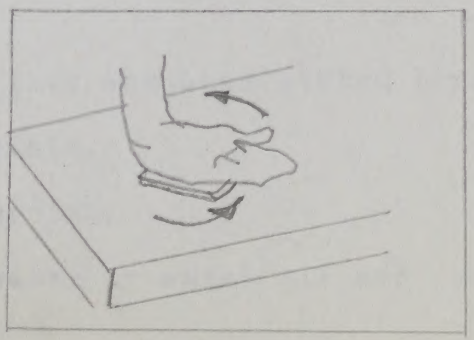
Special Instructions

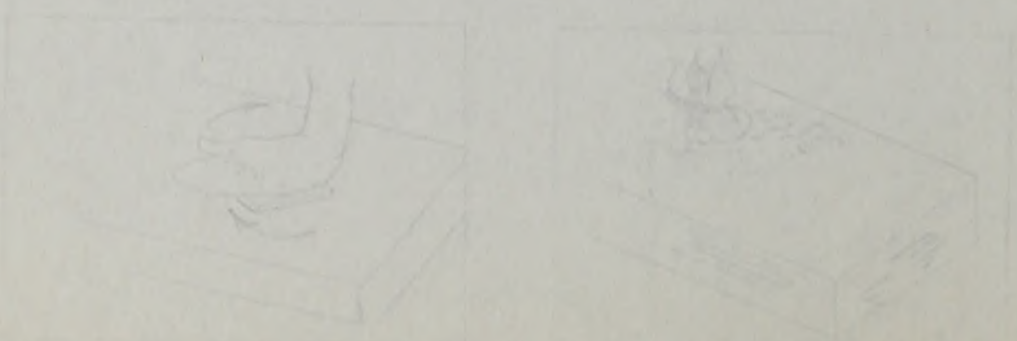
204. Varnishing and Polishing

D. Second Coat of Varnish

1. Pour small amount of unthinned varnish into open dish.
2. Fill brush well with varnish.
3. Remove excess varnish by drawing brush against side of dish or can.
4. Apply to surface with long firm strokes, working from middle toward both ends.
5. Allow to dry 72 hours.
6. * Rub with pumice stone and water, or pumice and oil.
   (1) Use No. F Pumice.
   (2) Put pumice into handkerchief and drop it gently onto the surface, leaving a thin dust.
   (3) Using soft piece of harness-maker's felt--3x5 inches--moistened with water or oil, rub in a circle over the varnish that is dusted with pumice.
   (4) Go over surface several times, but do not rub long in one spot.







Wood-Finishing

Special Instructions

204. Varnishing and Polishing

D. Second Coat of Varnish

6. Rub with pumice

(5) If pumice and water cake onto the felt, remove this caked pumice before using the pad again, as it will scratch the varnish.

7. When finish is smooth and dull, remove all pumice with a soft cloth moistened with raw linseed oil.

8. Rub with a dry cloth.

*

9. Allow to dry 4 to 5 hours.

*

E. Applying Last Coat of Varnish

1. Use high grade varnish.

2. Use perfectly clean and dry brush.

3. Pour varnish into open dish.

4. Apply varnish quickly and carefully, starting from middle of surfaces and working toward both ends.

*

5. Allow to dry several days.

*

6. Take new piece of felt or one that has been well washed.

7. Use No. FFF pumice that has been sifted through 2 layers of cheesecloth.

8. Dust pumice onto varnish.

9. Moisten felt with water or sweet oil and rub in a circle.

Wood-Finishing

Special Instructions

204. Varnishing and Polishing

E. Applying Last Coat of Varnish

10. Do not rub long in one spot.

11. Wipe off with soft cloth moistened with sweet oil.

* 12. Let dry 4 or 5 days.

F. Polishing

1. Use rotten stone.

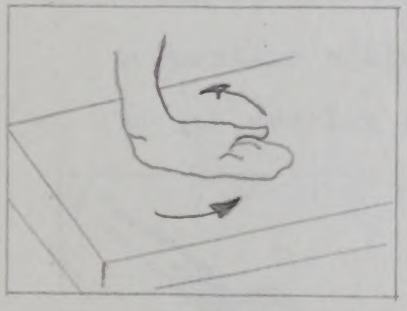
2. Use piece of felt or palm of hand, moistened with sweet oil.

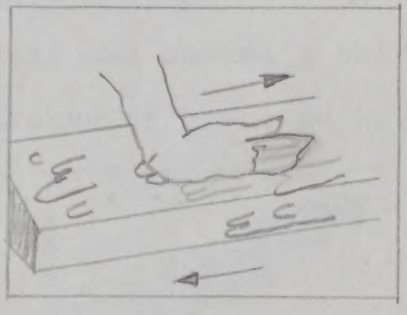
3. Sprinkle rotten stone over surface and rub with felt or hand <u>in a circle</u>.

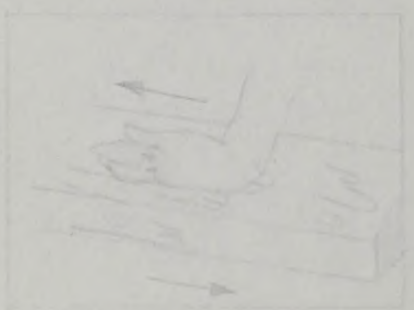
* 4. Then rub <u>with</u> the grain of the wood.

5. Wipe off with soft cloth moistened with sweet oil.

* 6. Polish with soft dry cloth.





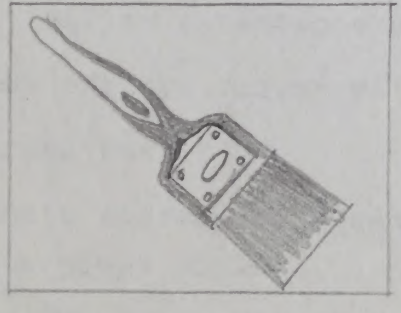


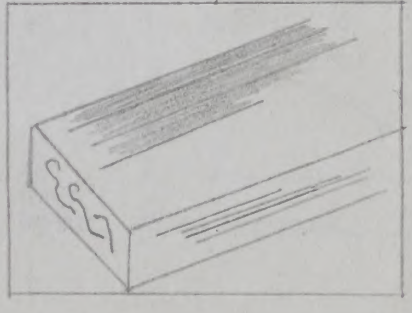
Wood-Finishing

Special Instructions

205. Enameling and Painting

1. Prepare new wood with liquid filler. See Instruction Sheets, 203 A, B, C.
2. When second coat of shellac has been rubbed down, and surface cleaned off, apply enamel priming or under coat.
3. For large surface, use 2 1/2 inch beveled tip varnish brush with bristles set in rubber.
4. For small surfaces, use smaller brush with long fine bristles.
5. Allow under coat to dry 24 hours.
6. Rub down with No. 00 sandpaper, with the grain.
7. Clean surface well.
8. Apply enamel:
   a. If enamel is thick, thin it with turpentine until it flows like varnish. Too much turpentine will dull the enamel's shine.
   b. Do not overlap strokes or brush marks.





9. Allow 48 hours to dry.

Wood-Finishing

Special Instructions

205. Enameling and Painting

10. Rub down enamel:

a. Use piece of felt, 3 x 5 inches.

b. Moisten enameled surface with water.

c. Sprinkle fine pumice on lightly.

d. Rub enamel with felt in small circles.

e. Add water and pumice several times.

f. Rub until smooth. Do not rub long in one spot.

11. Wipe surfaces with soft cloth.

12. Let dry 3 to 4 hours.

13. Apply second coat of enamel.

14. Allow to dry 2 or 3 days.

15. Rub to a gloss with pumice or rotten stone and water. See Special Instructions for Polishing, Sheet 204 F.

206. Enameling Wood that has been finished before

1. Remove all old finish.

a. Use Paint Remover.

b. Follow directions on can.

2. Wash off old finish with turpentine.

3. Smooth surface with sandpaper. See Special Instruction Sheet 201-6.

4. Then enamel, as with new wood.

## Wood-Finishing

Can you guess the answers to these riddles?

It was a night as black as ink. But I looked at my watch and could see that it would soon be midnight. How was it possible to tell?

My map of the country showed runways for giant airplanes, hangars, buildings of all sizes for tools, machines, and for men. Yet as I flew over the land pictured on my map, I saw nothing but trees, hills, and a small river winding toward the ocean. Did my map tell lies?

The flames swept through the back of the theatre but at the stage curtain they were slowed long enough for the people in the audience to get out safely. What kept the fire back?

The town ordered the big iron bridge to be painted green. Yet when the contractor put on a good coat of red paint, the townspeople were pleased. Why?

These riddles are all answered by the same word: PAINT. The faces of watches and clocks, and the dials of many gauges are painted with luminous paint that contains phosphorous and which glows in the dark. So paint can make us see things that are usually hidden.

Other paints can seem to hide what is really in plain sight. We call this kind of painting, Camouflage. Paints of different colors are used, together with nettings, branches of trees, grass, and such things, to make buildings seem to

disappear into a hillside, perhaps, and more paint gives us a little river where no river flows. Paint is used to camouflage ships, too, using colors that from a distance make the ship look like part of the ocean.

Paint can be made fireproof by mixing it with asbestos, borax, or other materials. In theatres, the fire laws require that a big curtain made of asbestos be hung inside the heavy cloth one. Besides this, all the paint on the stage and around the stage opening must be fireproof. Then if a fire breaks out back-stage, it will be slowed down at the stage opening long enough for the people in the audience to get out safely.

No wonder the town was pleased when the contractor put a good coat of red paint on the iron bridge, even though they had ordered it to be painted green. Iron rusts quickly when open to the weather. But paint made of red lead and raw linseed oil is especially good to prevent iron from rusting. So anyone who does a good job of painting things made of iron, puts on a first coat of red lead paint, and then gives it one or more coats of the color that was ordered.

Years and years ago when many men made their living by sailing ships from our coast cities to foreign lands, they had to put their ships into dock every few years to have the barnacles taken off the ships' bottoms. These barnacles are sea animals that look like flat plates. After a long voyage through warm waters especially, the ships' bottoms were covered thickly with weeds and barnacles. This slowed down the ships' speed. Our ships today are somewhat protected from barnacles and weeds by a special paint that gives off a sort of poison

in salt water. This poison keeps the barnacles and weeds from sticking to the ships' bottoms as long as the paint is in good condition.

How long has man used paint? It has been known and used for thousands of years although each year adds new kinds of paint to our lists, and gives us new ideas for old kinds.

The first paints were made of colored earth and this is still the basis of our best paints today. The finest outside paint is made from white lead and zinc oxide; the anti-rust paint comes from red lead, and the longest wearing black paint is made of asphaltum. All these materials for making paint come out of the ground.

Is there a lake or a large pond near your home? How surprised you would be to wake up some morning to find that the lake was filled, not with water, but with pitch or asphalt! Asphalt is that black tarry material that you see on our black-top or macadam roads. And black asphalt comes from a lake--a whole lake of asphalt! The asphalt is used in many ways: for the roads, and to make some kinds of black paint.

People who know how to use paints, can work magic with them. They can make a room look large or small, warm or cool, with high or low ceilings--depending upon the color paint that they use. What colors make you think of heat? Red, yellow, orange, and shades of these colors? What colors are dool and cold? White, green, blue, gray? Do you have a room with little sunshine that seems cold in winter? Paint or paper it in one of the warm shafes and feel the warmth come into it!

You know that the Indians used paint to make themselves look fierce when they went on the war path. Soldiers today use paint for camouflage, to make themselves look like the land around them so that their enemies cannot see them easily. Why does our government use olive drab paint for all of its trucks, jeeps, big guns, and airplanes for use on land, and blue drab paint for all uses on water? The olive drab and blue drab blends with the scenes around so well that the equipment is hard to see from a distance. If you look at this paint carefully you will notice that it does not shine. A shiny paint reflects light like a mirror and so gives away the secret it is supposed to hide. These olive drab and blue drab paints are used in huge quantities and therefore require great amounts of linseed oil to make them. But linseed oil is necessary also for food and other uses. So now olive and blue drab paint is being made with petroleum to give it body--the same petroleum that makes our gasoline, motor oils, etc. This camouflage paint is not supposed to last five years or more as linseed oil paint does. But it is good paint just the same.

What gives paint its shine? And what is shiny paint used for? Why do we need shiny paint and flat dull paint? If you think that you know the answers to these questions, check up on yourself.

Paint is shiny or dull depending upon how much varnish it contains. Enamel such as is used for inside woodwork, contains much varnish besides its color and a dryer. It can be washed over and over like a china plate. Flat dull paint contains but little varnish and has little or no shine. Most types of

flat paint are not washable and do not wear as well as enamel does. Another invention of the world of paint is the quick-drying kind. Lead and oil dry very slowly, taking several days to become thoroughly hard. People wanted apint that would dry in much less time. Men went to work on the problem and now we have a 4-hour enamel for indoor painting. And only recently, a resin paint has been developed that is mixed with water and so will dry in an hour. Yet after it has set, this paint will be as washable and as long-wearing as the kinds that take longer to dry.

Another kind of quick drying paint is lacquer. It is used principally upon metals. It dries quickly and smoothly, has a dull or bright finish, and can withstand heat, cold, water, and alcohol. Lacquer is hard to put on with a brush so it is usually applied with a spray gun. Lacquer is made in beautiful colors or in a clear colorless kind that is used like varnish to protect the surface below it and to give it a shiny finish. On automobiles the door handles, radiator caps, metal trim, and other metal surfaces have been treated with lacquer to keep them from rusting in wet weather.

How does paint wear on the decks and sides of ships that are always wet with spray, rain, or snow? Over long years, paint has been improved to make it tough enough to stand lots of scrubbing, wear, and weather. Nowadays, we may use deck paint for the floors of our houses and porches where they get the heaviest wear.

Our best wearing varnishes were developed for ships, too. The spars and cross arms from which the sails are hung were varnished to make them last longer. All the woodwork of the ship that was not painted, was varnished to make it last. To stand the water, varnish had to be tough. Varnish is made of the hardened gum or sap of ancient trees, which is mixed with oil, turpentine, and a dryer. It is the gum that gives the varnish its hardness, while the oil gives it its strength. Spar varnishes, so named because they were first developed to use on the spars and other woodwork of ships, contain much gum or resin and are tough and long lasting.

Sometimes wood is finished with shellac instead of varnish. Shellac is a gummy or resinous material that is found on the twigs and branches of some trees in southern Asia. It is caused by an insect that makes tiny holes in the bark of certain trees in order to lay her eggs there. The natives of these countries break off the twigs bearing the gummy material. These twigs are called stick-lac. Then the lac is dried, pounded from the twigs, and melted. It is now called seed-lac or grain-lac. The grain-lac is put into sacks and strained by twisting the sack. This twisting forces the melted lac out through the holes in the sack cloth. The strained lac is poured onto clean planks to harden into cakes or shells. The shellac is dissolved in various materials but alcohol is most commonly used in this country. Shellac gives a hard shiny finish that will not show scratches and will stand harder wear than will varnish.

Some kinds of paint can be burned. This paint is used to make colored glass which is used in some church windows. Plain glass is painted in a pattern, a design, or a picture. Then the glass is heated to a great heat so that the glass itself softens and the paint becomes a part of the glass.

Most ordinary paint, though, will not stand heavy heat. It will crack or peel off. But women wanted their steam-radiators, water boilers, and stove pipes to look bright and shining so men went to work to make a paint that would stand heat. They developed metallic paints which are made of metallic dust and a kind of oil, together with a dryer. Metallic paints turn dull in color after being on for some time and need to be renewed. But they do not crack or peel from heat.

Paint is used to warn people of danger. What colors are used for railroad crossing gates, at underpasses, and on walls or trees at sharp curves of the highway? Yes, black and white, or black and yellow. These colors do not fade into the landscape. They stand out and catch one's eye to warn of danger.

Painting with a brush takes many hours of a man's time. So when spray-painting was developed, one man could do the work of several men in the same length of time. Spray paint goes into the cracks and crevices that are hard to reach with a brush. It spreads evenly over the surfaces, and dries quickly. Our spray painting machines today are being used to spray rubber paint inside the plywood gas tanks of airplanes to make them leak-proof. These plywood gas tanks are used to carry the planes' extra gasoline for very long flights. They are dropped overboard when they are empty.

Perhaps the most costly paint of all is not really paint, although people speak of it that way. Many fine buildings in our country and in large cities all over the world have roofs shaped like half a ball. These roofs are called domes. Most of these domes are gold-colored and they shine brightly when they are first painted. But the weather, with its heat, cold, rain, snow, and wind finally wears some of the gold away and the rest is dirty and dull. What is used to make these domes golden and beautiful again? What else should be used but gold itself? Yes, the domes are really covered with gold. It is not paint at all. It is a very fine gold dust or powder called gold leaf. The domes are of metal and must be carefully cleaned and scraped before they are repainted. Then a coat of a sticky material is painted on, doing a small section of the dome at a time. This sticky material is allowed to dry for some time until it is very very sticky but not runny. Then the gold leaf is applied over it and pressed hard into the sticky material. When the whole dome has been gilded in this way, it will shine as brightly as the sun and can be seen for miles and miles.

A new paint containing plastic is now being sold in small quantities. It dries with a hard tile finish for walls and with a surface like a china plate for use on woodwork. These plastic paints will clean like a china plate, too, and will last longer, stay clean longer, and wash more easily than do our present-day inside paints. Plastic paints are not yet in wide use since they are to be bought only in small amounts, at the present time.

Other new paints for our future use will be made of a material to absorb daylight. Then on cloudy days and at night we will use less electricity for this paint will shine from the daylight it absorbed when the sun shone. Still other new paints will be fluorescent and will give off a light of their own so that with them, too, we will use less electricity.

Yes, paints have been used for thousands of years but the magic that men can do with them is still being discovered. What will the next fifty years of paint-making bring to us?

# Wood-Finishing

## Evaluation

Directions:

Here are some riddles that you should be able to answer now that you have finished this unit. If you do not know the correct answers, you are not ready to start on your special jobs.

### Riddle I

Henry has made an Adirondack chair for the lawn. It is ready to paint. He is at the hardware store choosing the paint. He is trying to make up his mind between a can of green deck paint and a can of green enamel. If you were the clerk in the store, what advice would you give Henry? Why?

### Riddle II

Bill and Tom are making bookcases just alike. They are now sandpapering the side boards and shelves before putting them together. Bill is carefully rounding all his edges and is rubbing with short hard strokes, back and forth across his boards. Tom is leaving his edges square and is rubbing his sandpaper block up and down his boards. Both boys are working hard. Which boy will have the better looking bookcase? Why?

## Riddle III

Last week Dick finished putting the fourth coat of varnish on his new table lamp. The lamp is shaped like an airplane zooming up to the ceiling. Dick put on good thick coats of varnish, one coat each day for four days, being careful not to touch it until he put on the next coat. The varnish is still not dry and the whole thing looks muddy. Dick thinks that somewhere he has made a mistake. How many mistakes do you find that Dick has made?

Evaluation

II. On Background Information

Directions:
Check the correct ending to each sentence below:

1. We can see the hands and face of some watches and clocks in the dark because they are
   - so big.
   - painted with phosphorous.
   - painted with aluminum.

2. Other paints can seem to make hills, houses, planes, and boats disappear. This kind of painting is called
   - luminous.
   - calcimine.
   - camouflage.

3. By mixing asbestos or borax with paint, it can be made
   - fireproof.
   - to hide houses, boats, and planes.
   - to show in the dark.

4. We use paint made with red lead
   - for barns.
   - for danger signals.
   - to rustproof iron.

5. The bottoms of ships are now covered with a special paint
   - to make them rustproof.
   - to keep barnacles from forming.
   - to make them go faster.

6. The first paints were made of
   - berries.
   - bark.
   - clay.

7. Rooms painted in shades of orange, red, yellow, and brown will look
   - warm.
   - cool.
   - dark.

8. Rooms painted with light ceilings will seem
   - low.
   - high.
   - small.

9. Paint with a high gloss cannot be used on war equipment because
   - it does not wear long enough.
   - it reflects light like a mirror.
   - it is too expensive.

III. On Background Information

10. Gloss paints contain much
varnish.
turpentine.
lacquer.

11. Varnish is made from
aluminum.
hardened sap of trees.
shellac.

12. Some of the newest paints look like a china plate because they are made of
varnish.
plastic.
gold leaf.

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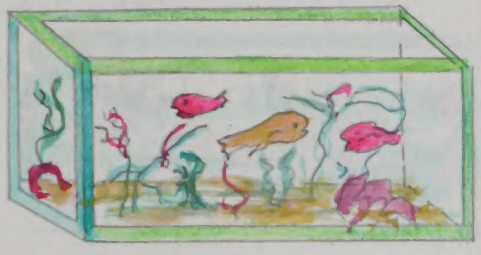
Glazing

# Glazing

## Related Optional Activities

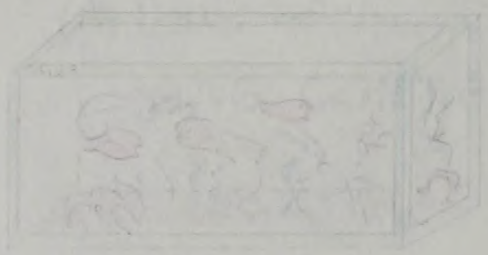
### Making an Aquarium Tank

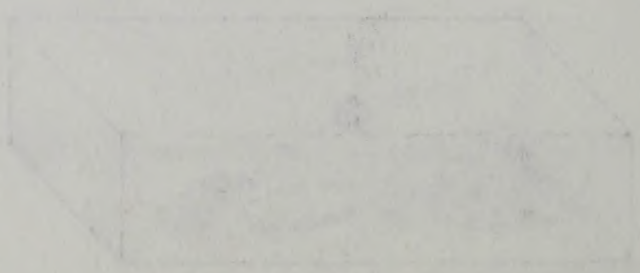
Do you like tropical fish, guppies, and tadpoles? Would you like to build your own aquarium? It is expensive to buy such a tank yet the materials are not too costly if you can put them together yourself. Some people are so clever in building such tanks that they can install the electric lights to keep the water at the right temperature and to light up their beautiful fish. Can you do that?



### Glass boxes for Powder, Trinkets, etc.

Would your mother like a beautiful glass box for her dressing table? You give her gifts on Christmas, Valentine's Day, Easter, and Mother's Day, to say nothing of her birthday. It takes very little glass to make such a pretty box. Have you clever hands for such work?





# Glazing

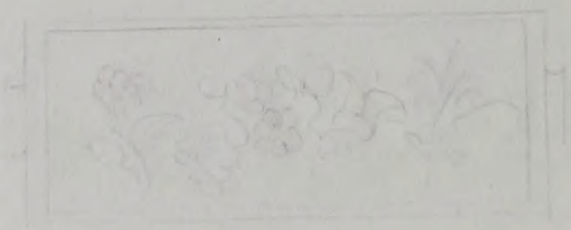
## Related Optional Activities

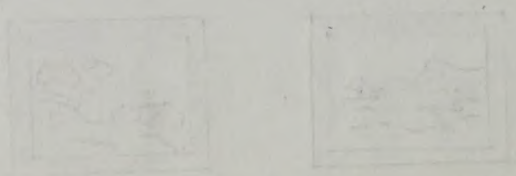
### Glass-bottomed Trays

Do you think that your mother would like to have a glass-bottomed tray with flowers, grasses, and butterflies pressed under the glass? Other trays have beautiful patterns cut from wall paper or cloth glued to a colored background. Such trays are very pretty when they are finished. You must plan far enough ahead for this work to save the prettiest flowers, grass, and the most beautiful of butterflies when they can be found. Trays made with wall paper or cloth, of course, can be made at any season of the year.

### Framing Pictures

Have you saved some pictures that would look well in frames but no one has ever taken the time to do it? And is there a special place on the wall waiting for a picture? Then now is the time to do it! For the larger pictures, you may need to buy some glass. If the pictures are small, and you have larger pieces of broken glass at home, you will not even need to buy the glass, just frames of the right size, for you can cut the broken glass to fit the frames.





Glazing

Pre-Tests

I. Tools and Materials used in Glazing

Directions:

Check the tools and materials needed to glaze a window.

| | |
|---|---|
| putty knife | linseed oil |
| saw | varnish |
| pliers | whiting |
| hammer | ruler |
| brads | Try square |
| chisel | paint |
| putty | plane |
| sharp knife | sandpaper |
| glass cutter | emery paper |
| glazier's points | new glass or large broken piece |

II. Procedure used in Glazing

Directions:
The order of the following items for doing this job is not correct. Number the items below in the right order to tell how to do the job correctly.

Apply linseed oil to sash and let dry.

Remove sash.

Scrape sash well.

Remove old glass, putty, and glazier's points.

Measure new glass to fit.

Use glass cutter, with Try square on the line to be cut.

Paint sash first coat.

Spread putty in groove.

With glass cutter, score glass completely through the first time.

Bevel putty.

Start break in glass.

Put in rolls of putty.

Clean glass and let putty dry.

III. On Background Information

Directions:
Some of the following sentences are true and some are false. Put T in front of the sentences that are true. Put O in front of the sentences that are false.

1. Safety glass is made in a sandwich.

2. Glass bricks cannot be sawed or drilled.

3. Some glass is made so that you can look out through it but not in.

4. Glass dishes cannot be used over great heat without cracking.

5. Glass is too brittle to be used for cloth.

6. Flowers and fruit made of glass look so real that you have to touch them to know that they are made of glass.

7. Some glass is so light that it is used in life rafts.

8. Lenses for spectacles and goggles are being made to change daylight to look like night.

9. When cutting glass to size, you cut it to the exact measurements of the opening.

10. Putty that is hard and solid is useless and should be thrown away.

11. There is a huge mirror being made to use in a giant telescope that will make the moon and stars seem much nearer to us.

12. Plate glass is made just as our window glass is made.

13. Most glass is made partly of sand or quartz.

14. Window glass was always made by drawing it out in big sheets.

## Question Sheet

When you finish this job you will be able to answer each of the following questions. How many of them can you answer correctly now? As you follow the directions on the Work Sheet, see how many answers you find to these questions.

1. Look at the pictures of the tools needed to glaze a window. How many of them can you name? Of how many do you know the use in the job of glazing?
2. Only 5 materials are needed to glaze a window. Can you list them? Compare your list to the list on the work sheet.
3. A glazier cleaning a sash to be re-glazed wears gloves. Why?
4. The glazier uses a dull chisel to scrape the frame clean of dried putty and bits of broken glass. Why is the dull chisel used?
5. In scraping the sash, the glazier uses short firm strokes of his chisel, pushing away from himself. Why?
6. Your instructions say that all raw wood should be treated with 2 or 3 coats of linseed oil which is allowed to dry over night before applying the putty. How do you recognize raw wood? Why does it need to be treated with oil? Why does it take over night for linseed oil to dry?
7. When you give the clerk in a hardware store the exact measurements for a pane of glass, he always cuts it 1/8 inch shorter and narrower, yet the glass fits your frame. How is this possible?

8. There are two reasons for removing all broken glazier's points before re-glazing a window sash. What are these reasons?

9. All instructions for glazing a window tell you to put an even coat of putty on the rabbet before laying the glass in the frame. What are two reasons for doing this?

10. Of what metal are glazier's points made? Why? Did you know that they are placed into the frame with an upward slant? Why are they so placed?

11. Of what is putty made? If it is too hard, how can it be softened? If it is too soft, how can it be stiffened? What is the test for putty that is just right to use?

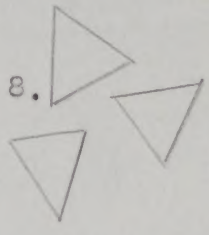
12. How can you tell a good job of glazing from a poor one? Can you tell at once after the job is done, if it will wear well?

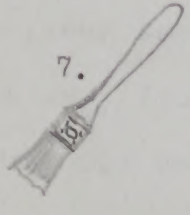
# Glazing

## Tools and Materials

Tools needed for Glazing a Window

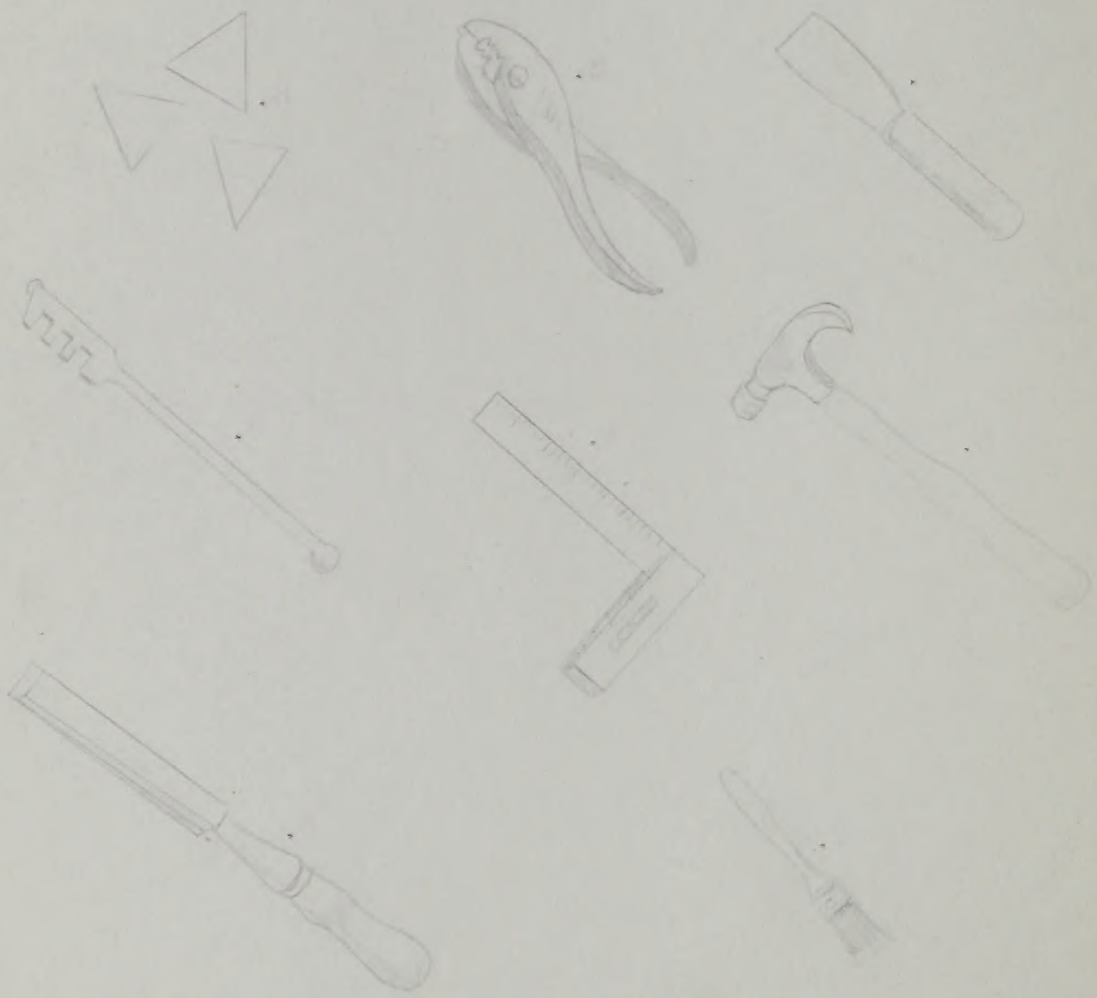
1. Putty Knife
2. Pliers
3. Hammer
4. Scale
5. Glass Cutter
6. Chisel
7. Sash Brush





Materials Needed for Glazing a Window

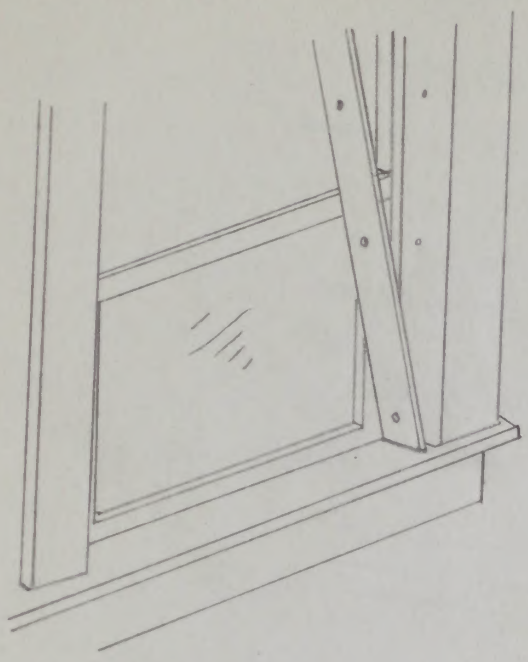
8. Glazier's Points
9. Putty
10. Sandpaper
11. Glass
12. Paint

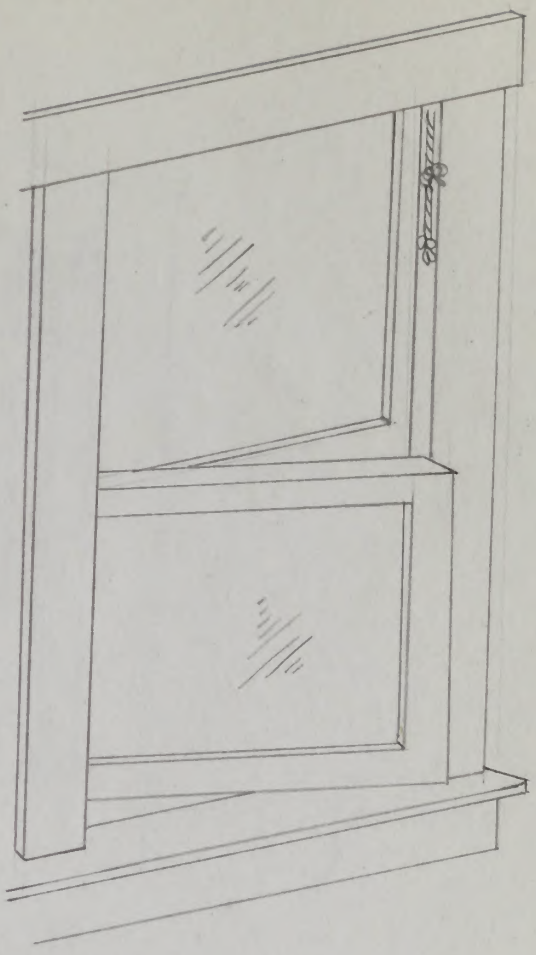


# Glazing

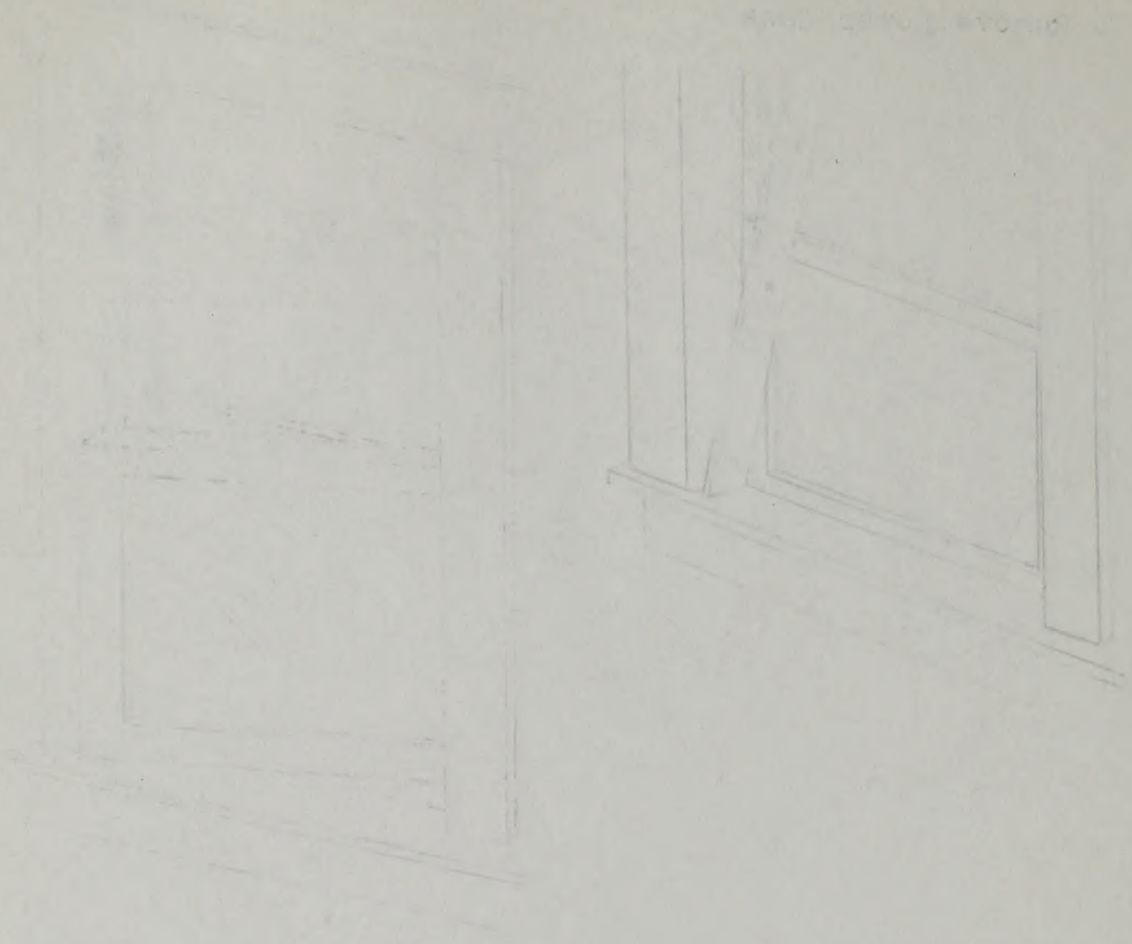
## Special Instructions

A. To Remove Lower Sash





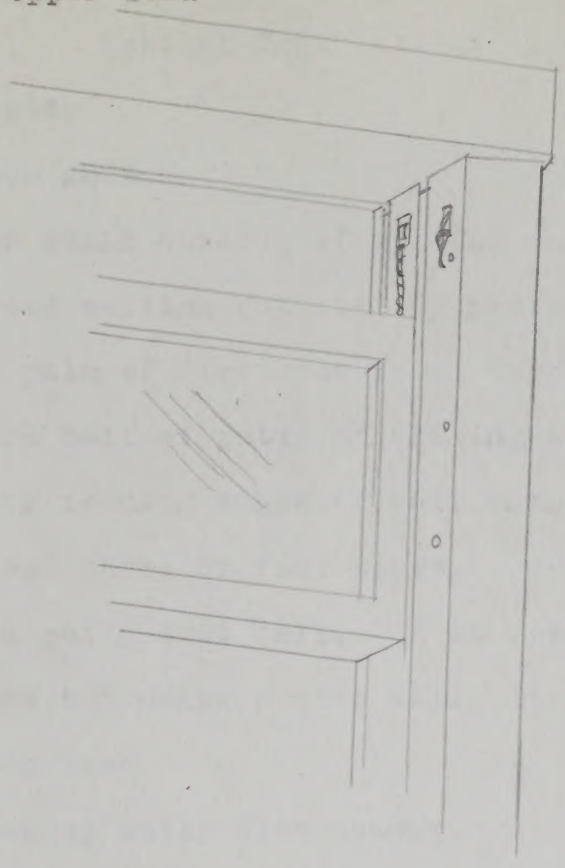
1. Take off window stop on one side. Right side of window usually.
2. Cut paint along joint of asah if stuck. Use sharp knife.
3. Pull out lower sash at right side of window.
4. Slip sash away from window stop at left side of window.
5. Pull sash cords away from grooves on each side of window.
6. Tie a big knot in each cord so that they cannot slide through pulley.



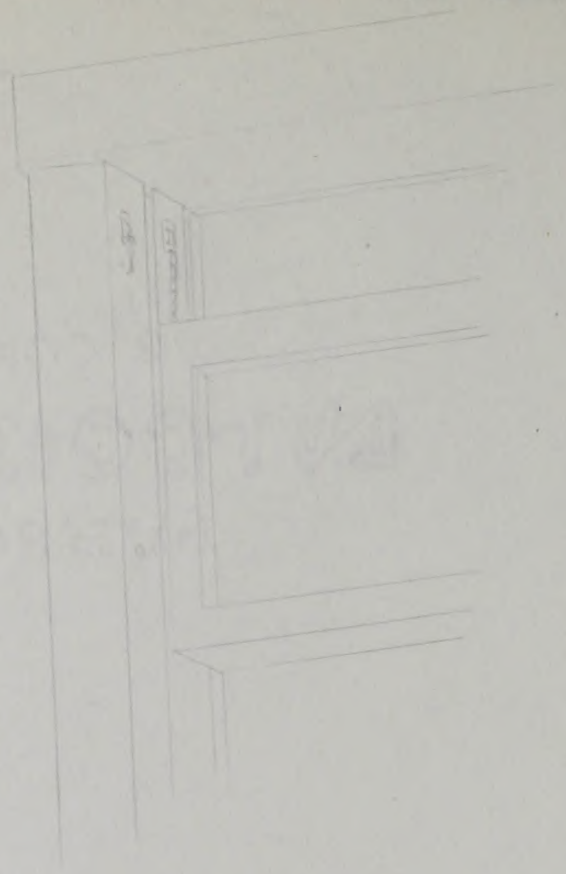
Glazing

Special Instructions

A. To Remove Upper Sash



1. Remove lower sash. See Special Instructions.
2. * Pull out window stop on right side of window.
3. Pull sash down from top for 4 inches.
4. Pull out sash on right side.
5. Loosen window cords.
6. Tie big knot in each cord so that they cannot slide through pulley. *



# Glazing

## Special Instructions

B. Preparing Putty

1. Putty too soft

   a. Pour small handful of whiting onto paper or board.

   b. Spread whiting out flat by pressing it down with the palm of first one hand, then the other hand.

   c. Place ball of putty on whiting and knead it lightly by folding edges of ball into middle.

   d. Repeat three or four times.

   e. Roll putty into ball. If it does not stick to hands but makes a soft ball, it is ready to use.

2. Putty too hard

   a. Break up putty with hammer.

   b. Add teaspoon of linseed oil.

   c. Stir linseed oil into putty thoroughly.

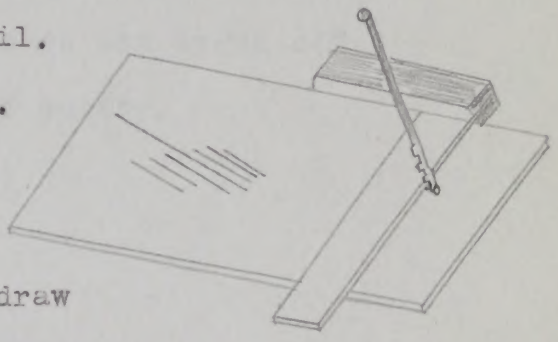
   d. Continue to add linseed oil one teaspoon at a time until putty makes a soft ball that is stiff enough to stay together, yet does not stick to hands.

# Glazing

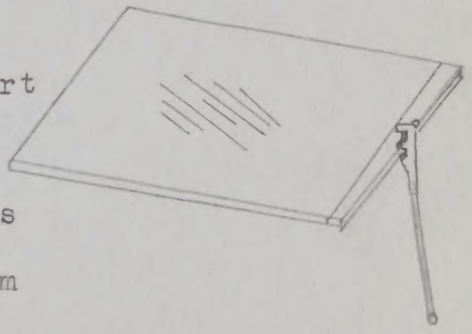
## Special Instructions

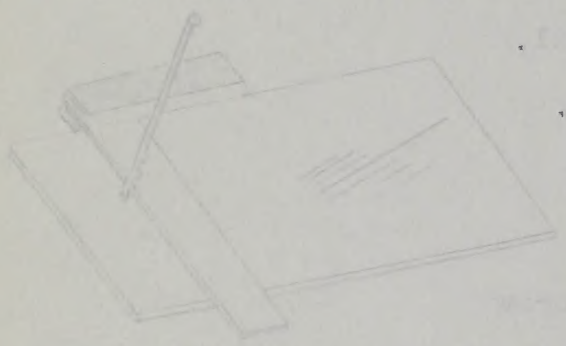
C. Cutting Glass to Fit

1. Measure inside of frame carefully.
2. Subtract 1/8 inch from width and length measurements.
3. Lay pane of glass on table padded with several layers of newspaper or a piece of blanket.
4. With Try square, make one edge of glass square.
5. Using straight edge or Try square, measure glass carefully and mark with pencil.
6. Check all measurements twice.
7. Lay Try square on line to be cut. Holding glass cutter against edge of Try square, draw draw cutter firmly down line to be cut.



8. Make a complete scoring the first time. Do not go over any part of the line.
9. If waste piece is small, start break with jaws of cutter.
10. If very small pieces of glass do not break off, remove them with jaws of cutter.



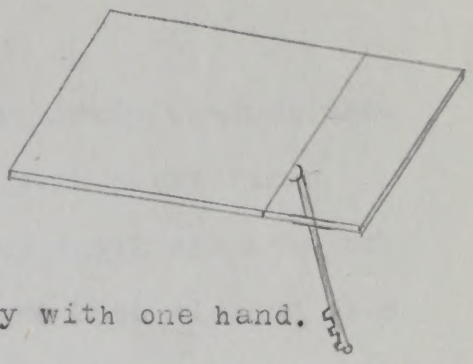


Glazing

Special Instructions

C. Cutting Glass to Fit

* 11. If waste piece is large, tap underside of scored line lightly with handle of cutter until scored line spreads.



* 12. Grasp edge of waste firmly with one hand.

13. Lay other hand flat on new pane and press down firmly on waste piece of glass.

14. If small pieces of glass do not break off,

* remove them with jaws of cutter.

# Glazing

## Procedures

I. Cleaning and Preparing Sash

1. Remove sash. See Instruction Sheets A and B.
2. Put on heavy gloves.
3. Take dull chisel. Press chisel firmly against sash frame, and push away from body with short firm strokes. Continue this scraping until all bits of dried putty and broken glass have been cleaned from the sash.
4. With pliers, pull out any glazier's points that stick out from frame.
5. When frame is cleaned of all glass, putty, and points, rub with coarse sandpaper to smooth all rough spots on frame.

*6. Now examine frame carefully to find all spots of raw wood. Raw wood shows bright yellow against the wood that is still covered with some finish.

7. Use small paint brush and apply linseed oil to spots of raw wood. Brush oil in well,
8. Repeat oil treatment two or three times. This oiling of the raw wood is necessary to make the putty stick to the wood.

*9. Let frame dry over night.

Glazing

Procedures

II. Measuring and Bedding Glass

1. Measure length and width of glass carefully from inside edge of opening.

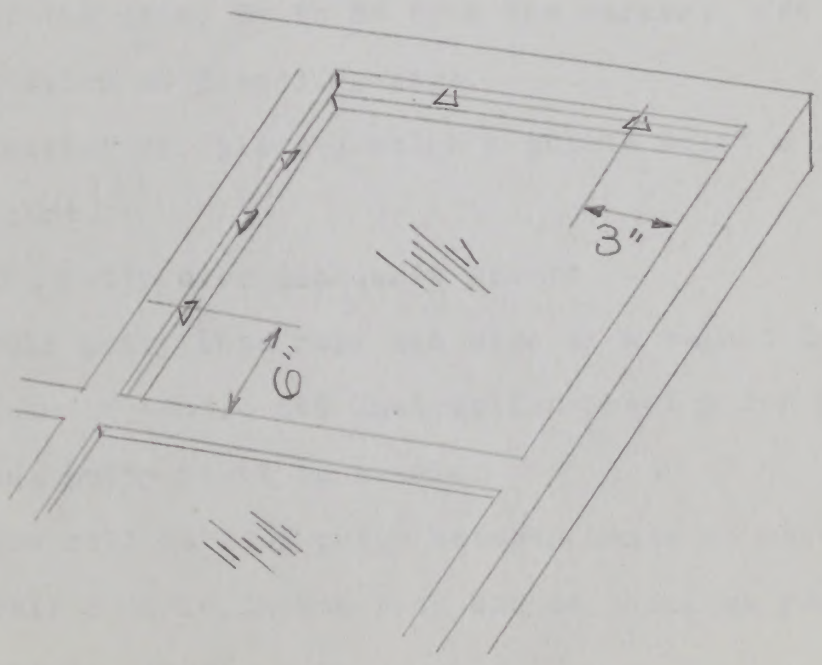
2. If you are buying glass, give the clerk the exact measurements.

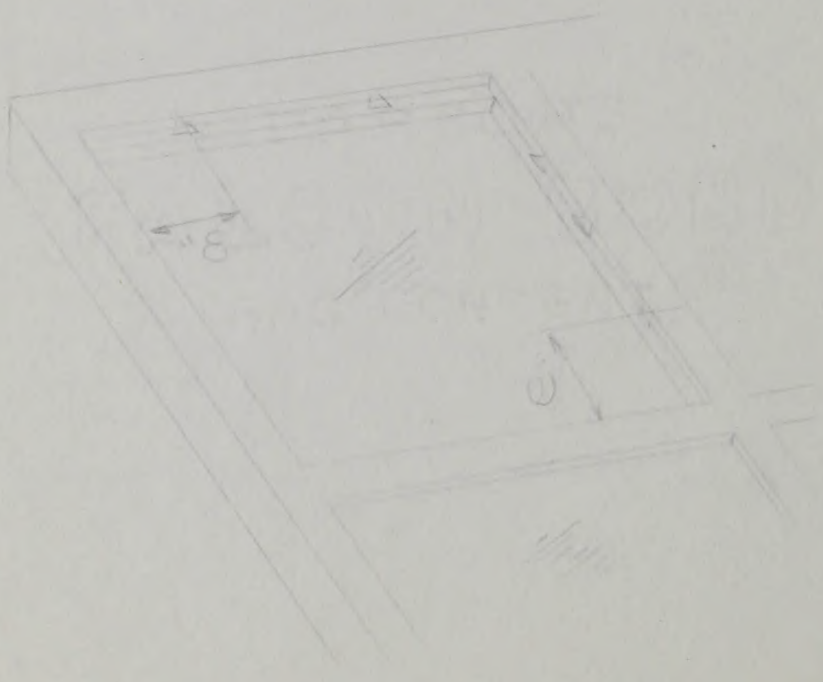
3. If you are cutting the glass yourself, see Instruction Sheet C on Cutting Glass to Fit.

4. Spread putty evenly 1/8 inch deep in groove (rabbet) to make all edges even, and to make firm bed for plass.

III. Securing Glass with Glazier's Points

1. Place glazier's points 3" to 4" from corner, on the short edge of the glass.





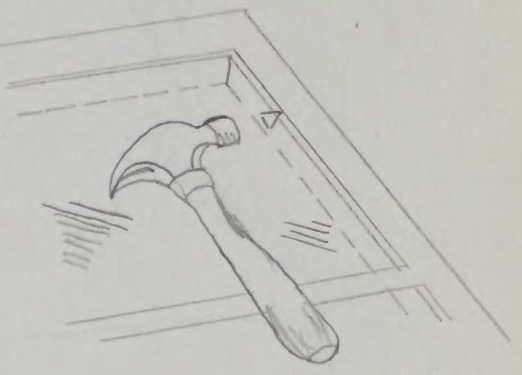
Glazing

Procedures

III. Securing Glass with Glazier's Points

2. Start glazier's points slanting upward into wood. If the wood of the frame is very hard, a small slit may be made with the corner of the putty knife or chisel to start the point in.

3. Using hammer with a sideward motion, slide it over the glass to tap in the glazier's points.



4. Tap in points until their edges are even with the edge of the rabbet below the glass.

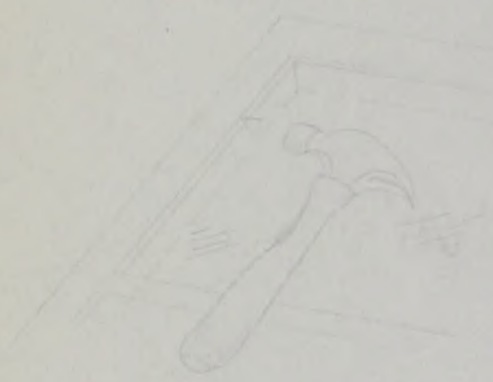
* 5. Put second point around the corner on the long side of the pane, 6" to 8" from the corner. See illustration on preceding page.

6. Thereafter, place glazier's points about 6 inches apart.

* IV. Applying Putty over Glazier's Points

1. Roll putty into ball the size of a walnut in the palm of hand. See Instruction Sheet B for having putty right to handle.

2. Now roll ball of putty between hands to make a roll 8 to 10 inches long and as thick as your middle finger.



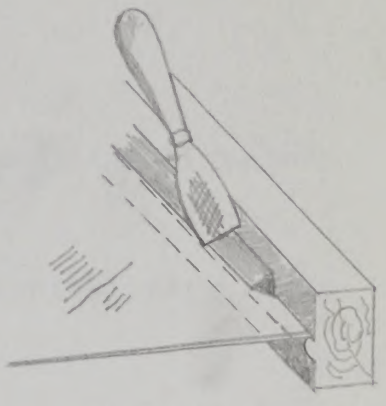
Glazing

Procedures

IV. Applying Putty over Glazier's Points

5. Lay roll of putty on glass over glazier's points, tight up against frame.

4. Take putty knife and slant it to rest on frame and glass.



5. Draw putty knife toward you, beveling putty to an even slant. Press knife down firmly.

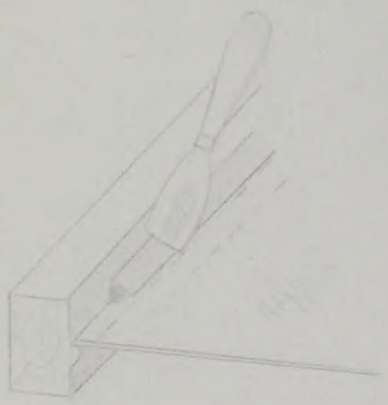
* 6. If putty wrinkles, draw putty knife in opposite direction.

7. With other hand, remove extra putty from knife.

8. Bevel corners of putty into a V, with point to meet corner of frame and rabbet.

* 9. Clean loose putty from frame with putty knife held nearly flat on glass. Be careful not to nick new putty.

* 10. Allow putty to dry.



Glazing

Procedures

V. Painting Sash

1. Using sash brush, paint sash and brush paint in thoroughly.
2. Be sure paint covers putty but does not extend out onto glass.
3. Let paint dry 48 hours.
4. Sandpaper lightly, and apply second coat of paint.
5. Let second coat dry 48 hours.
6. Remove any paint spots from glass with putty knife and turpentine.
7. Clean glass carefully with soap and water, or with commercial window wash.

## Glass

How many uses of glass can you think of? Five? Ten? Twenty? There are hundreds of uses and more are found every day. We have glass in our house windows and another kind in the big store windows. A glass sandwich is used for the safety glass in the windows of automobiles and airplanes, and it can be ground to make lenses for goggles, too. Glass can be sprayed onto curtains, chairs, walls, and many other things to make them fireproof.

Remember the little pig who made his house of bricks? The old wolf huffed and puffed but he could not blow down the little pig's brick house. Think how very cross the wolf would have been if the bricks had been made of glass so that he could have seen the pig's shadow as he walked around inside! In many cities today, buildings have been built of glass bricks that can be sawed and drilled. Translucent glass bricks that let in light but keep out sounds are used for inside walls.

That same little pig would have had more fun with the wolf if he had had windows of one-way glass. He could look out but the wolf could not look in!

But best of all, if that pig had his glass brick house today, he could put a huge glass pot of water right on the fire to heat. Then when the wolf fell through the chimney into that glass pot, the little pig could have watched the old wolf cook for his dinner without taking the cover off his glass pot.

The story of Cinderella and the glass slipper would be even more wonderful if we wrote it today. Cinderella could wear not only glass slippers but a glass dress, too. She could have the most beautiful glass flowers to carry--so real to look at that only the bees could tell the difference.

To what kind of palace would the prince take Cinderella today? It could be made of glass brick or of any other building material. But there would be glass everywhere of course, because Cinderella liked glass. Glass would help to heat the palace. Huge glass windows that made one whole side of a room would let in the sun so that the heating bill would go down. And yet, Cinderella's palace would not be hotter in summer because of the extra sun, for these huge windows slide open, giving much better air. And the slant of the roof is just right to let in the full sun in the winter and to keep it out in the summer. Of course, the other walls and the ceilings of the palace would have glass wool insulation, too, which keeps out heat or cold.

Will the palace have glass furniture? All the curtains and draperies could be of glass for we have glass today, in any color, that can be spun into threads as fine and as soft as silk. The walls in the bathrooms and the kitchen may be of colored glass that will not fade, crack, or mar. Table tops, shelves, and doors may all be of sparkling colored glass, or of clear shining glass. There are no cinders in Cinderella's kitchen--the stove is as shining as a jewel with a glass oven that lets one see just how the dinner is cooking without opening the door.

If you would like to see some magical glass flowers you should visit the museum at Harvard University in Cambridge, Massachusetts. There you will see the only collection of glass flowers and glass fruit in the world. The glass flowers are of the exact colors and sizes of the real ones. They are the work of two German masters in glass work--a man and his son, who have spent their lives at this work. There are glass fruits, too, that look real enough to eat. And there are other fruits, that look partly spoiled by disease. Fruit growers in our country can go to this museum to study these diseased fruits so that they can develop ways to stop the diseases.

Can you imagine glass so light and airy that men in our army and navy use it for pontoons for bridges and for life jackets and life rafts? The rope that is fastened to the box kite that flies above the men on the life raft is made of glass, too. That kite rope had to be a special one--it had to be strong, light, and durable. And it had to stay strong, light, and durable even in great heat or cold, in salt water, in rain, and in sun. The fibres of that kite rope are made of glass so fine and flexible that they can easily be braided into a strong rope. The kite rope is important because it is wound with the radio antenna so that the men on the life raft can send their SOS for help.

How do spectacles help us to see better? The lenses are ground to make things look to our eyes as they really are. Some of us need glasses that make things look bigger. Others

need glasses that make things smaller. Many people have more serious eye troubles but the lenses can be ground to help nearly everyone to see well. Some lenses do quite wonderful things. The lenses of the goggles used by our flyers would seem to us to be made of magical glass. It is safety glass so that it will not break into bits. Some of these goggles have two sets of lenses, one behind the other, that can be turned in such a way that the light of day can be made dimmer until the pilot can look almost into the sun. Then he can discover the enemy flier who thought to hide in that brightness. Other goggles have lenses that are used to look at moving pictures to discover camouflaged land that does not show its secrets when one uses ordinary glasses. There are other lenses that can be used in flight training to change bright daylight flying to blackout or night flying. Most of these goggles are used with colored plastic shields which change the amount and color of the light that the pilot usually sees through his flying goggles.

Do you know how big 200 inches is? Figure it out in feet or yards. Measure it out on your playground. Then draw a circle around the line. Now imagine that huge circle is a mirror. Yes, a mirror. Out in California there is a 200 inch mirror now being ground and polished to go into a telescope through which men are going to look at the moon and the stars. This huge mirror will make the moon and the stars seem much nearer to us. The men will study them to learn if anyone lives on the moon and if the shadows that we see are mountains, rivers, or just clouds of dust.

What goes into the melting pot to make glass? And how is glass made into the things we use? Glass is made mostly from soda ash or potash, sand or quartz, and lime or lead oxide. If it is to be colored glass, metallic oxides are added. The finest grade of ruby red glass is made with gold as part of the "batch. The colored glass for stained glass windows such as one sees in churches is made with these metallic oxides or by painting the glass and burning the color into it.

Did you ever blow soap bubbles? Then you know a bit how the first glass-makers worked. Their pipes were long though and they dipped them into pots of molten glass. If the glass-blower wanted to make a small vase, he blew into his pipe just so and at the end of it the glass bubble was shaped into a vase. If he wanted a huge bowl, he blew into his pipe another way and there was his bowl. All our window glass used to be made in that way, too. The glass-blower dipped his long pipe into the pot of molten glass. Then he stood over a deep pit and blew. At the end of his pipe came a glass bubble that grew longer as he blew. When it was long enough, the glass cylinder was cut from his pipe. While it was still warm, the long glass cylinder was cut open and spread out into a sheet. When the sheets of glass were cold, they were cut into smaller pieces to be used in windows. The piece of glass where the long bubble had been hitched to the blow-pipe had a bullion or "bull's eye"in it--like the center of a target. This piece was used only as decoration in the windows of the old houses. Hand-blown window glass is uneven in thickness and one sees things in queer

shapes when one looks through the hand-blown panes.

For many years all our window glass was blown by hand. Then machines were invented that blew the long glass bubbles. Now, however, our window glass is made by machines that draw out the sheets of glass as you would draw a towel through the wringer. These sheets of glass are often 8 feet long by 7 feet wide.

The glass used in store windows is not made like our house window glass. It is called plate glass and is much thicker. It is made by rolling the molten glass just as your mother rolls pie crust. The molten glass is spread on iron tables covered with water and it is rolled by huge machines. After cooling, the sheets of rolled glass are cemented by Plaster of Paris to great round tables. The glass is then ground and polished until it is smooth on one side. The huge sheets of glass are then turned over to be finished on the other side.

If the glass-makers of olden times could see our glass cloth, build with our glass brick, cook in our glass cooking dishes, or look at the moon and stars through our giant telescope, they would think themselves in a land of magic. Perhaps it is.

# Glazing

## Evaluation

I. Tools and Materials used in Glazing

Directions:
Check the tools and materials needed to glaze a window.

| | |
|---|---|
| glass cutter | ruler |
| linseed oil | hammer |
| whiting | chisel |
| Try square | sandpaper |
| plane | paint |
| emery paper | brads |
| putty | pliers |
| glazier's points | putty knife |
| varnish | saw |

new glass or large broken piece

II. Procedure used in Glazing

Directions:
The order of the following items for doing this job is not correct. Number the items below in the right order to tell how to do the job correctly.

Scrape sash well.

Set glass with glazier's points.

Apply linseed oil to sash and let dry over night.

Spread putty in rabbet.

Start break in glass by tapping under side of glass with handle of cutter.

Remove sash.

Use glass cutter with Try square on line to be cut.

Remove old glass, points, and putty.

Paint sash first coat, brushing paint in well.

Measure new glass to fit.

Put in rolls of putty.

Clean glass of bits of putty, and let sash dry over night.

Bevel putty.

With glass cutter, score glass completely through the first time.

III. On Background Information

Directions:
Draw a ring around the word or words that end these sentences correctly.

1.. Glass made like a sandwich is called
window glass.
safety glass.
plate glass.

2. Glass bricks can be
transparent or opaque.
hot or cold.
broken and chipped.

3. Glass dishes are made mostly of
sand.
quartz.
metals.

4. Glass cloth is
soft and fine.
stiff and brittle.
of little use.

5. Two men spent their lives making glass
animals.
houses.
fruits and vegetables.

6. Glass that is light and airy is used for
life rafts.
life boats.
radios.

7. The huge mirror made by the Corning Glass Works is to be used for
a microscope.
a diving bell window.
a telescope.

8. Stained glass for church windows has in it
paint.
no sand.
metallic oxides.

9. The finest ruby red glass contains
silver.
red paint.
gold.

III. On Background Information

10. Most of our glass is made of
    sand or quartz.
    rocks.
    Plaster of Paris.

11. Window glass in the old days was made by
    blowing bubbles.
    rolling.
    drawing it out in sheets.

12. Plate glass is made by
    blowing bubbles.
    rolling.
    drawing it out in sheets.

13. Hard putty can be made soft again by adding
    turpentine.
    linseed oil.
    whiting.

14. When cutting glass to size, you
    add 1/8 inch to the length and width.
    add 1/4 inch to the length and width.
    subtract 1/8 inch from the length
    and width.

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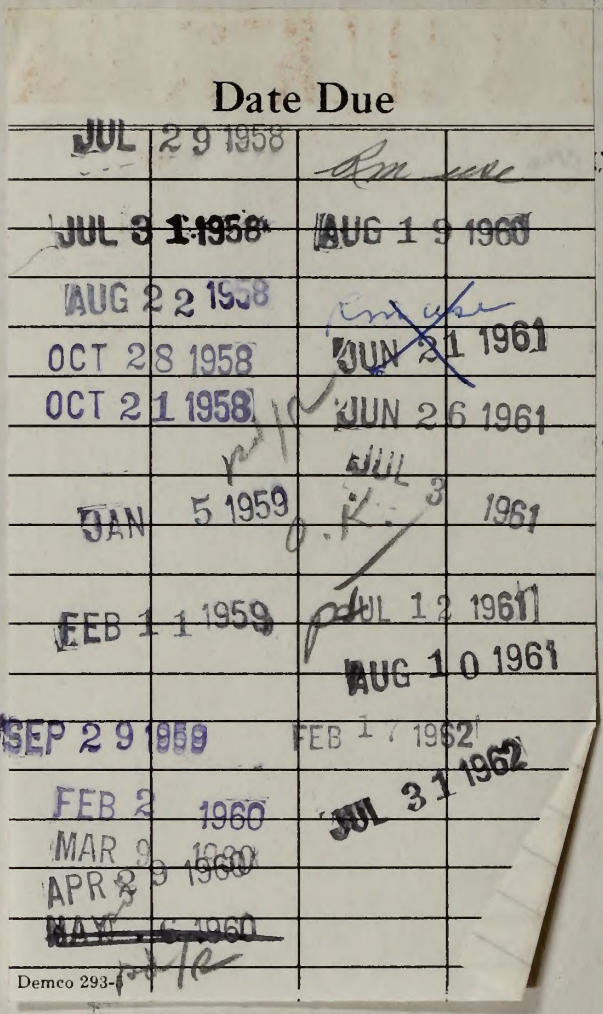

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